

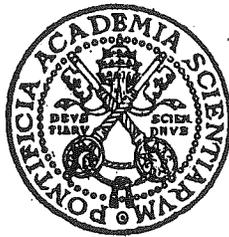
Study Week on:

MAN AND HIS ENVIRONMENT
TROPICAL FORESTS AND
THE CONSERVATION OF SPECIES

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ETHICAL ASPECTS OF THE IMPACT OF HUMANS ON BIODIVERSITY

DANIEL H. JANZEN and WINNIE HALLWACHS
Department of Biology, University of Pennsylvania
Philadelphia, PA 19104, U.S.A.
Instituto Nacional de Biodiversidad
3100 Santo Domingo, Heredia, Costa Rica

The ethical impact of tropical species' extinction and deforestation is like that of randomly burning books, and shelves of books, to heat the world's last library on a cold winter day. The elimination of conserved wildlands promotes biological illiteracy, intellectual malnutrition and environmental degradation.

STORY ONE. IN THE BEGINNING

Introduction

His Holiness chose Costa Rica as the center of operations for his 1983 Central American visit. A week ago, we asked one of our rural Costa Rican neighbors what he would say to Pope John Paul II if he had one sentence. He replied, "Tell him that Costa Rica is searching for more humanitarian ways to live."

This essay considers the interaction of ethics and conservation in the context of one country, Costa Rica. It is focused on Costa Rica because

- it is the tropical system whose biology and administration we know best,
- its problems are faced by nearly all of the tropics on a larger scale,

— it is well on its way as a pilot project in tropical problem-solving, and

— its new President, Rafael Angel Calderón, has selected national environmental management as a major administrative theme.

It is fitting to limit the discussion to a single country because of our backgrounds, and the discussion *should* be limited to one country because it is time to begin to move past airy generalities. Yes, the specific situation in any tropical agroecosystem can be profitably compared with other tropical agroecosystems, but only if inter-region differences are taken into account and the focus is on processes. All vehicles have a motor, fuel, steering and brakes.

By way of comment and definition, we also note here that the "agroecosystem" is everything from cow dung to Presidential Seal, from bean field to national park, from corner store to stock exchange.

This essay is regrettably long. It was tempting to reduce it to a few pithy sentences and paragraphs. However, the audience outside this room is so very diverse, with such diverse cultural and historical antecedents, that terse statements are guaranteed to generate major misunderstanding.

In the Very Beginning

As a hunter and gatherer, *Homo sapiens* was just another large mammal. Like the bear, the baboon and the beaver, the human altered the density, distribution and behavior of this or that prey species. But like that of other hunters and gatherers, human impact seemed to be small, ephemeral, and patchy. Humans seemed to dance with their prey and their associates. A step here and a step there. Humans were not even present in the New World.

A Big Experiment

And then humans performed their second large biodiversity experiment. They introduced themselves into the New World. *H. sapiens* arrived as a hunter-gatherer about 10,000 years ago, an immigrant across the Bering Straits. He found big game

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that lacked the genetic programs that screamed "danger" at the sight of a human and big game that lacked the protective morphology evolved in the presence of millions of years of humans as social tool-wielding predators. These Pleistocene humans, confronted by two continents of walking beef — a seemingly endless resource — invented not the refrigerator but the social killing machine.

Continent-wide extinction of the New World megafauna was the consequence. With the removal of the herbivores, many species of carnivores went too. The starving adult carnivores were even more thorough than were the human hunters in cleaning up the last vestiges of the herbivores. Along with the herbivores and the big carnivores went the vultures and the condors, and all the other scavengers of carcasses. Community structure readjusted in many directions. The food plants of all those herbivores breathed a sigh of relief and settled into a new kind of peace. Now they only worry about neighboring plants and million of herbivorous insects. The other prey of the carnivores — the ground-nesting birds, the wasp nest, the lizards, the frogs, the snakes, the small mammals — found themselves in a kind of paradise. Around us we still see the anachronisms, the momentos of millions of years of battle between those large vertebrates and their food plants — hard nuts around seeds, spines on trees, seeds the size that only an elephant can swallow and defecate whole, leaves rich in vertebrate poisons, fruits of flavors that only a browsing mammal would find of interest.

And the Pleistocene hunter was extinguished along with the other carnivores and the vultures. It was surely not gentle, any more than the crash of the agricultural human on the Yucatan Peninsula was gentle. "Dark ages" are not unique to Europe.

There is no hectare of the New World unaffected by massive human impact. To think otherwise would be like shooting the big vertebrates in Africa's national parks and then studying these parks' ecology as "natural". A school child learning biology and ecology in a Costa Rica natural park is suffering cultural deprivation generated by the second mass extinction of biodiversity by humans. What was the first big biodiversity experiment? The first *H. sapiens* to hit Australia did the same thing to that continent between about 50,000 and 10,000 years ago. What was another? Look at the cave paintings in Europe for the answer.

The Human Mutualist

And then humans became mutualists. They developed the singular trait of choosing a few wild plants and animals, and then removing other wild species so as to give their domesticates sun, water, feed, and freedom from predators and parasites. In turn, these domesticated species became dependent on human protection for their survival. In his own turn, the human mutualist became pinned to a geographic point. That is to say, humanity became a specialist at the replacement of the wild world with non-human biotic appendages of humanity. A corn plant and a guinea pig work for its owner almost as directly as does the owner's own hand.

But this process transformed the wild world from threat and source to almost pure enemy. Not an enemy through direct attack on humans so much as an enemy of humanity's mutualists, of humanity's biotic factories. The Costa Rican settler does not hate the forest so much as now that his rice plants cannot grow beneath it. If the Pleistocene hunter had not removed the Neotropical big game, it is certain that the first Neotropical agriculturalists would have. A one-ton glyptodont and a corn field are incompatible.

And the battle against wildlands thus became a social ritual, pursued as an end unto itself. And the full-blown harvest of the individual wild organisms — seeds, lumber, game, water, soil — for their own sake became socially quite acceptable. But the forest fought back. And the wild things ran ahead, and they hid.

But a rate change was in the wind. The wild world became abruptly confronted by head lamps, guns, steel snares, parathion, bulldozers, vaccines, FAX machines, trucks, chainsaws, hybrid corn, fossil fuels, computers and paved roads. In less than a century the whole world did what previously had taken from millenia to ages. The rate of tool improvement has accelerated so rapidly that the hunter's technology has outrun the pace of evolution of his self-protective traditions. He passed the frontier stage at supersonic speed and with rockets, still driven by a frontier mentality. The modern hunter and gatherer can clear a wildland of its species and habitats far faster than the recipient society can invent its regulating traditions in the form of new legislation that is spurred by consequences for the public. And learning of these consequences takes even more time than their

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occurrence. Sometimes the consequences are irreversible. You can cut off your thumb only twice with your new chain saw. The passenger pigeons will never again darken our skies; the tapir has been extinct in El Salvador so long that Salvadorans believe incorrectly that it never occurred there.

Agricultural inviability has been the best friend that tropical conservation has ever had. If corn grew as well on tropical forest soils as wheat grows on temperate mesic prairie, there would be no tropical forest to think about saving. And biotechnology is fast rendering the concept of agricultural inviability a thing of the past. Shortly there will be no square meter of the rainy tropics on which one cannot grow marketable organisms.

These two processes — removal of wild competitors and harvest of particular wild species — moved inexorably ahead. The wild world transformed from source to enemy, to trivial bystander. Distant humanity, living in its concentrations of consumers and legislators, no longer recognized the wildland as source. Milk comes from milkbottles, potablé water comes from the faucet, and drugs come from drugstores. The free-form trashing of the world's wildlands continues as a byproduct of naive pursuit of the social good. If you dance in the freeway, you get run over. But maybe some freeways should have been put somewhere else? Even the most naive urbanite understands that fried eggs do not come from fried chickens.

Village Traditions

The Pleistocene hunting village had no restrictive traditions prohibiting the cutting of trees. The African forest farming village had few restrictive traditions about the harvest of big game. As mutualists with their domesticates, humans have always fully exploited their social and physical environment until a feedback mechanism sends them a bill. And then humanity loves to change address. There are no noble savages living in altruistic peace with the natural world, but there have been many wise and battle-scarred ones. And what we call traditions are social statements that prevent us from performing the acts that bring the consequences down on our heads.

We are born a stack of blank computer disks and a small set of basic programs. Those disks are today being filled largely with the flotsam and jetsam of about 500 years of human scramble

across the world's frontier, the frontier that appeared as humans crossed their many and different Bering Straits. Today's young Costa Rican is largely not receiving, for example, the biological literacy and environmental traditions that are appropriate for either the individual or society in a stable and sustainable agroecosystem on their or any other size resource base.

What we discuss here in this study week is the reinvention of our (village) traditions. Individual humans can no longer escape the consequences of our actions, no matter how distant. We have found storage and transmittal that can work across the world. We have extended our fingers and eyes with magical tools. The shade from the trees over the Vatican fuels the forest fire in the national park where we live in northwestern Costa Rica. The frontier is gone. It is time for civilization to reappear. The 20-family village functions through traditions; so must be the case with the billion-family village.

STORY TWO. THE DESIGN OF HACIENDA COSTA RICA

Conservation

The conservation of tropical biodiversity in Costa Rica has until very recently been a few heroic Costa Ricans protecting apparently virgin nature against the onslaught of a humanity that has been primarily occupied elsewhere. This struggle has also been aided by the simple inaccessibility of many wildland areas to a society that has not wished to wander far from its roads and electricity. And as mentioned earlier, this struggle has been greatly aided by the fact that the rural tropical farmer and rancher has up until now been working largely with a biotechnology invented by his ancient ancestors.

However, about 1985-1986, for a plethora of reasons, many private and government individuals in Costa Rica saw that barbed wire and guns could never be successful for long at conserving wildland nature. Likewise, it was obvious that for all the agricultural inviability of the rainforest, there would shortly be a Costa Rican somewhere for whom a miserable existence on a rainforest farm seemed better than starvation elsewhere. It became clear that the only surviving wildlands would be those that were imbedded in the minds and pocketbooks of Costa Ricans. Finally, it became clear that those wildlands were major sources

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of Costa Rica's water, power, intellectual stimulation, recreation, ecotourism dollars, national heritage, and future economic potential. They are Costa Rica's oil reserves, and little by little — but every day more rapidly — this awareness is being woven into the Costa Rican social and economic fabric.

Today, this weaving is in full motion. There are 8 Areas de Conservación (AC) or Conservation Areas comprising about 25% of the Costa Rican national territory. Each AC is a mosaic of wildlands for the conservation of biodiversity and wildlands for sustained forest production. All are administrated so as to become strongly integrated with the intellectual and economic fabric of the surrounding communities, and all are viewed of huge potential in the development of Costa Rica as a single large natural resource management unit. This can perhaps be best expressed by the expectation that far more of their budgets will be spent on items of social interaction than of strict protection *per se*. The AC outreach has logically moved hand in glove with the formation of a separate Ministry of Natural Resources, Energy and Mines, and the strengthening of non-profit, non-government, organizations (NGOs) that promote natural resource management at all levels in society. Interdigitated with these actions has come the evolution of the National Biodiversity Institute. The private, non-profit, institution is dedicated to determining what occurs in the conserved areas, and packaging that information in a format that will allow it to be used by Costa Rican and international society at large.

This brave beginning is an experiment, and as such demands many caveats, many changes of view, and much, much work — all by many people. But then, again, perhaps it should. It is reasonable to expect the use of 25% of a country to be a major industry, a major cost, a major benefit, and a major social impact. Conserved wildlands are no longer paintings on the wall; they are mainstream society.

Hacienda Costa Rica

How would you plan Hacienda Costa Rica?

The Hacienda is 50,000 km² of the deep tropics, bounded by two oceans, and topped by mountains 2-3,000 m tall. It is populated by 3 million people, nearly all of whom are descended from invaders and immigrants who arrived within the past four cen-

turies. Its real per capita income is about \$2,000/year and its per capita international debt is among the highest in the world. Its unemployment rate is 5.5%. It has no fossil fuel of its own. As mentioned above, roughly 25% of the country still bears wild-land vegetation. The remainder ranges from urban centers, to fields and pastures, to abandoned marginal ranchland and farmland. Being tropical, most of Costa Rica is agropastoral real estate of low grade by temperature standards. A half million species of organism live in Costa Rica.

Costa Rica is small enough — in many respects — that inter-person impact and inter-person responsibility looms large, but big enough to be an economic and biodiverse nation state.

Any planner of a large agroecosystems asks, among other questions, what can be grown where, and who are the consumers of that produce?

When one of us stood in the middle of a muddy stream in Corcovado National Park and asked a gold miner what is a national park, he replied "a place to protect the fauna and flora, and I am careful not to do anything to the flora and fauna." Then the question was, "Yes, but what about the shrimp that used to live in the stream you have destroyed with your gold mining?" A long pause. Then, "Well, but señor, there are a lot of shrimp in the ocean." When a Costa Rican is caught doing something illegal, his first and often second reaction is not to grovel and not to grab a gun, but to argue that in fact it is OK. It is a nation of lawyers and shopkeepers - and planners.

The Costa Rican feels some control over his or her destiny, and pursues that control with vigor. That is to say, the Costa Rican has a rapidly growing understanding of acts and consequences. Costa Ricans are desperately interested in what can be grown, where, and who are the consumers of that produce.

The Costa Rican Consumer

What is a consumer? Traditionally a consumer is defined as a person. In the tropics, a person is very commonly defined as some set of minimal nutritional requirements plus basic social services (perhaps education unto literacy, minimal health care, minimal feedback to government). The ethical planner defines a consumer in a quite different manner. A consumer is defined as the amount of resources required to offer a standard of living

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that is roughly equivalent (at least) to that expected by the occupants of what is called the "developed world". Here, we translate this to mean the amount and kind of resources that allow full intellectual and physical development of the individual. It is critical to note, however, that the society with a per capita income of \$10,000 may easily have a standard of living that is five times that of a society with a per capita income of \$2,000, but doubling the per capita income from \$10,000 to \$20,000 is very unlikely to double the standard of living. You can simultaneously eat only so much good food, read only so many good books, go to only so many good doctors, live in so many good houses, etc.

The 1989 World Almanac notes that the per capita incomes of Great Britain, Japan, Sweden, France, Italy, Spain, Canada and the US in 1985 were \$7,216, \$10,266, \$11,989, \$13,046, \$6,447, \$4,490, \$13,000, and \$13,451, for an unweighted average of \$9,976. In the same year, Costa Rica's per capita income was \$1,352. This figure should be increased to at least \$2,000 because in calculating Costa Rica's per capita income, home-grown produce is not included, and Costa Rica contains a very large number of small farmers and ranchers. The basic comparison is that Costa Rica is producing about \$2,000 income per capita, and the eight "developed" countries mentioned above average \$10,000 income per capita.

These figures lead to the inescapable conclusion that if each Costa Rican aspires to a standard of living roughly equivalent to that desired and enjoyed by the average consumer in a developed country, either the productivity of Costa Rica has to be increased five times, or the number of consumers supported by Costa Rica has to be reduced by 80%, or some combination of these two events needs to occur. It is safe to assert that almost every Costa Rican aspires to a standard of living roughly equivalent to that desired and enjoyed by the average consumer in a developed country.

The GNP of Costa Rica's agroecosystem can perhaps be doubled by very clever management of the agroecosystem. But there is absolutely no way to increase it five times. Furthermore, the standard ways to increase GNP — greater investment in fertilizers and pesticides, more infrastructure, greater training of workers, etc. — generally lowers the net productivity per unit invested, a productivity that quickly approaches zero in most tropical habitats.

How Many Consumers?

So, how many consumers can Hacienda Costa Rica support? If we decide that the GNP of the Hacienda can be managed up into two times its current level, then Costa Rica need sustain only a 60% reduction in populace. This leads to the conclusion that approximately 1,5 million \$10,000 per capita incomes could have been supported by Costa Rica in 1980, 50% of those present today.

It is quite striking that a 40-50% reduction of population in Costa Rica would reduce the consumption of basic agricultural crops by this amount as well. Would these crops then be available to sell on the international market? This would convert a portion of Costa Rican basic production into goods and services, the sale of which would raise the standard of living for the remaining populace more than would having yet another (cheaper) grain of rice, kilo of beef or shrimp for internal consumption. Is the goal kilos of humans, or units of books, computer and compact disc players?

What is the significance of focusing on the standard of living of the consumer? The significance is that no matter how clever we are, no matter how masterful we are at designing Hacienda Costa Rica, no matter what domesticates are put where on the Hacienda, Costa Rica's standard of living will not be anywhere near what the members of its populace hope for unless it accepts the challenge of determining how to fine-tune its consumer numbers to the size of its resource base. That is to say, Costa Rica has to re-invent the traditions characteristic of any non-frontier stable state. And if its standard of living is not at least that of a developed country, Costa Rica will continue to be walking misery for a substantial fraction of its inhabitants, continue to erode the resource base, and continue to grow in population number. All of these things will continue to lower the standard of living for those who stay. This is otherwise known as institutionalization of the poor.

Overstocking the pastures leads to low quality livestock and pasture degradation. To put it in other terms, the addition of each new calf to the pasture is prejudicial to the livestock in the pasture in both the short and long term.

And focusing more narrowly, the most masterful program for the care and feeding of a marvelous tropical wildland will be useless unless it is a part of an agroecosystem that provides a per

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capita income that is similar to that aspired to by the developed world's standard of living and that views tropical wildland biodiversity as an important member of the domesticates in the human toolbox. This needs to be done in different ways in different tropical societies. In Costa Rica, the individual (ex-)frontier farmer — at many different income levels — is often the focus. Elsewhere it may be the members of a village, an age class, a religion or a nationality.

The options for Costa Rica are clear. She can have a very poor large population that understands how wildlands contribute to it not being poorer still. Alternatively, she can have a significantly smaller population with an average standard of living for a developed country, and understand how the wildlands are a major contribution to this standard of living. Theoretically, she could even have a wealthy population that views a conserved wildland as a nice toy. The third option is only very distantly available, if at all. It is for Costa Rica today to choose between the first and second options. The epitome of moral irresponsibility is to attempt to maintain 3-5 million consumers on a resource base that can at best sustain 1,5 million consumers with a reasonable standard of living.

STORY THREE. WILDLANDS AS A DOMESTICATE, AS A CROP

Introduction

Wildlands are a domesticate, a crop. They exist, if we please, where we please. Just as you manage a rice field for its rice and that its pesticide runoff does not poison your drinking water, a wildland needs to be managed for its produce and in a manner that its "agrochemicals" do not destroy more of it than it produces. Both of these operations require that the society, the planning and consuming structure understand the nature and value of the wildland crop in the intellectual and economic picture.

Can we reach a level of understanding where we speak of replacing a rice field with a wildland, just as today we speak of replacing a rice field with sorghum? Can we speak of managing a wildland of various products just as we speak of managing a ranch for various products? It is not that the key to the AIDS vi-

rus could be found only in a tropical dry forest, but it is notable that at one time maize was nothing but a grassy weed on a Mexican rocky hillside and the bamboo fowl (known to you as the chicken) was a noisy denizen of Indian thickets. Many a lesson learned as a child on the farm or camping trip has moved a Wall Street magnate through the urban jungle.

Our collective social knowledge has clearly reached a level at which we can view blocks of wildlands as simply another kind of crop. Such a view risks offense to those with a strong attachment to the definition of a wildland as a place without human influence. However, as was discussed in Story One, it is an illusion to think of any of the earth's terrestrial surface as free of major human impact. Additionally, the recognition that it is within human control to destroy any national park in no way diminishes the beauty, power and economic importance of that park. The same applies to the Mona Lisa and the Seven Wonders of the World.

While this story's topic is that conserved wildlands are a crop, the essay's subject is the ethical aspects of social bonding to a wildland. A major social goal is crop development for production of intellectual goods, services and income, and economic goods, services and income. But this comes about through social bonding as well as through technical exploitation.

However, Costa Rica can no more blanket itself with conserved wildlands than it can afford to blanket itself with monoculture conventional crops. For example, the AC Guanacaste, a 100,000 ha dry forest AC in northwestern Costa Rica, has an annual net production at least five times that of the low-grade ranch and farm land that once stood where the AC stands. It supports four times as many heads-of-household as it did before it began in 1986, and the employment is far more intellectually healthy. Most of its income and much of its intellectual influence flows into the surrounding communities in the Zone of Influence. However, even the staunchest advocates of AC Guanacaste are quick to point out that this does not mean that all of the 1,1 million ha of Guanacaste Province should be turned back into conserved wildlands (though it is technically possible). Like any ranch, Hacienda Costa Rica needs different crops in different places for different goals. Wildlands are one such crop.

The development of this crop demands new kinds of contracts and mutualisms between previous antagonists — the great bulk of humanity and the administrative/scientific elite.

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Parataxonomists, biodiversity prospecting, tropical water rights, native tree plantations, rainforest regeneration, biological literacy, reducing family size, etc., are all outcomes of this new kind of interaction. The global frontier is gone and we all live downstream from ourselves.

Care and Feeding of the Wildland Crop

The biology of conserved wildlands is not the focus of this essay. However, the biology of tropical wildlands that conserve their biodiversity has some salient management features that deserve mention.

Conservation science has, quite unfortunately, become the domain of much academic discussion. Wildland conservation *per se* is an area that takes far more farming common sense than scientific research. Where the scientific research comes into play is not through the direct management of the site so much as in developing the information from it that will be of use to society — thereby giving the conserved wildland crop its full value.

A few examples:

1) Many wildlands can be put or restored where you want them. All that is required, usually, is stopping the perturbations that endanger or alter the habitat desired. For example, stop the fires, logging and hunting, and letting the wild world move back onto the land — *provided that there is an adjacent seed and animal source*. We have been led somewhat astray by those who quite reasonably have stressed that once extinct, always extinct. This is true for species, but often not true for forest communities. Every bed of a river, every landslide, is a natural exercise in restoration biology. Fund-raising for traditional conservation often seems bolstered by the assertion that tropical forests are irreplaceable, but this stance leads quickly to the false conclusion that 95% of the tropics is now forever doomed to be trashy fields and ill-used pastures.

2) All forests have already been perturbed by humans. This means that whatever we save is damaged, so there is no great philosophical problem with saving a noticeably perturbed site. That is to say, many small tropical national parks will never again see a jaguar or white-lipped peccary. But when your Rambrandt is fire singed or carved by a madman, you save it anyway. The small, and somewhat impoverished national park

can still be a fantastically intellectual stimulus, watershed protector, ecotourism generator, etc., for its immediate neighbors. Three quarters of a library is far better than none at all.

3) Bigger and more diverse is better than smaller and less diverse. So how big? Take as much size and diversity as you can get without generating horrendous social problems today. And then dedicate your energy to weaving that site into its surrounding society. In other words, set the boundaries by social considerations. If we lose 5% of the world's biodiversity but gain perpetuity for the remainder, all of humanity has won. We cannot be the librarian in a burning library who refuses entry to a fireman because the water hose may damage some books.

4) In most parts of the tropics it is best to make the wildland boundary choices now, as tropical civilization jells out of the frontier stage, and invest in the social solidification of the conserved wildland as a social good. Continued arguments over locations and sitings of national parks keeps the frontier mentality well alive. Let's keep Romeo and Juliet in the game.

The Intellect as a Product

Man the hunter, gatherer, agriculturalist and urbanite is fully dependent on a quite marvelous brain — marvelous that is, if fully developed. A tropical humanity shifts from human draft animal to cultured, experienced and educated manager of the agroecosystem, the occupants of the agroecosystem must have access to major intellectual development. There are two reasons. First, true sustained management of a real agroecosystem is extremely complex — and made even more so by the addition of world markets, futures, biodiversity prospecting, ecotourists, biotechnology, patenting, telephones, etc. Many of the best people in the society are going to be needed at the source of production, as well as in distant cities. The days of the absentee landlord are over. There were as many potential Nobel Prize winners in the 500 members of a Pleistocene hunter village as there are among 500 names drawn today from the London telephone directory.

Second, the non-wildland portion of an agroecosystem is a dull green hell, no matter how productive, how rational, how sustained. No one really lives in 10,000 ha of corn and it is not reasonable to expect anyone other than human draft animals to live in 10,000 ha of bananas, oil palm or rice — no matter how

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safe and sustainable are the fields. A rice field is a biotic factory. People do not live in factories, for obvious reasons. And those who are forced to want to live there even less. We have now had more than a century of concern over the welfare of the "tropical agricultural workers" — his and her health, roads, electricity, amusement and technical skills. But who worries about the development of the gray matter between the ears?

Throughout the tropics, and certainly throughout Costa Rica, properly developed conserved wildlands are the underutilized, undervisited and underdeveloped libraries, concert halls, national theaters, universities and city parks for those who manage the nation's biotic factories.

The Culturalization of Rural Areas

When natural resources are managed more competently, there can be an increase in real production from virtually any tropical rural area. This increase creates wealthier people who automatically have greater aspirations for themselves and their offspring. This means that simultaneously with the increase in income must come a local increase in the standard of living — better schools, better hospitals, better roads, better communications, better intellectual stimulation, etc. If these changes do not occur, emigration of these wealthier parents and offspring from the rural area to the urban area increases dramatically. Ironically, one of the driving motivations of hard work on the tropical farm is to escape the farm. This process automatically removes the types of persons who will be needed to manage the ever more complex agroecosystems.

At present, there is a severe brain drain from the Costa Rican rural upper and middle class to the urban centers. This movement seriously debilitates the decentralization and deconcentration that are now emerging in Costa Rica. That is to say, affirmative action for local hiring and explicit funding for rural institutions are not sufficient in themselves to effectively retain the well-trained and bright. Worse, as they move yet further up the social ladder, they are even less interested in a return to the rural environment from which they struggled to escape.

The rural brain drain is substantially less prominent in Costa Rican working class families. There is a huge underutilized intellectual resource in the Costa Rican countryside.

These people find it difficult to move out of the rural zone because they are flagged by racial background, language, dress, customs, etc. If they move to an urban environment, their economic and social status declines. In contrast to middle- and upper-class persons, many of these less mobile rural people do not show a strong willingness to remain in the countryside after experiencing an opportunity for intellectual development through strong institution-building in the rural world. This beneficial behavior appears as much related to local family ties and social bonding as to contentment with the "difficult" physical environment. It may also be related to the phenomenon that a given amount of personal development in a rural area may raise an individual relatively higher on the social scale than is the case in the "more sophisticated" urban environment.

The Technology of Intellectual Development through Wildlands

Costa Rica rightly prides itself on nearly 100% literacy — alphabetization, as it is called. However, the last two generations of Costa Ricans have lost nearly all of the pragmatic biological literacy that their grandparents had. One of the very most important roles of a conserved wildland is to deliver biological literacy to the nation's schoolchildren. The technology of this intellectual development is relatively simple — take all school children to the nearest wildland on a scheduled basis, as part of their normal curriculum. Teach them the natural history, ecology, physiology, morphology, behavior, evolution, etc., of the multitude of organisms present. This is not a program of occasional outings, but a highly structured and calculated academic exercise.

The biologically literate populace, thus created, is vastly more competent to take and appreciate wise decisions in environmental management than is the current populace of rural dwellers. At present, these dwellers have been stripped of their pragmatic contact with nature without receiving the urban advantages of complex schooling. This not nostalgia for noble savages, but pragmatism: the agroecosystem populace cannot be expected to take charge of its own destiny in a sea of ignorance of tides, current and winds.

When biological literacy takes hold, the agroecosystem populace must be given the reins to chart its own course. There is no teacher like experience. It is self-evident that biological

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literacy must go hand-in-hand with new capabilities in a multitude of other social areas traditionally well-developed only in major cities. Biological literacy must be reinforced through adulthood, just as must be mathematics, reading and dialogue. But let us not be deceived into thinking that biological literacy is just for dealing with nature. We are animals too. Grow a biologically literate child up into a lawyer, sawyer, candlestick maker, and that adult is likely to outperform an urbanite or a more traditionally trained ruralite in most social contents.

But the direct intellectual development by the wildland is not restricted to children. As wildlands become evermore a major domesticated crop, those who specialize in their management will be special contributors to society as a whole, just as medical doctors have their special place on the city council. The direct managers of wildlands, the analogues of tractor drivers and veterinarians on a traditional ranch, now find themselves in an honorable and challenging vocation. The parataxonomist is no mere bug collector, but an income-earning member of a town. Her children recognize an honest day's wage when they see it. The ecotour director is more than just a bus driver. As rural areas become sprinkled with those who manage wildlands for a living, a new species of vocation appears, one that champions intellectual ability, continual learning, curiosity, security in one's knowledge base, imagination, flexibility and equal sex ratios among employees. Such individuals are of ever greater value in the overall agroecosystem, as it moves from rice monoculture to full diversification.

The Value of Intellectual Development in Complex Use Wildlands

Costa Rica has lived four centuries of simplistic agriculture. Banana plantations are nothing if not boring. Coffee farms blanket the central highlands; it is because coffee is a drug crop with high yield per hectare that these fields generated a democratic society, not because monocultures lead in that direction. Guanacaste Province has on occasion been almost nothing more than a cattle pasture occupying 20% of the country.

Today the Guanacaste rancher recognizes fully that it is bad marketing to stay in the cattle business. The costs of cattle production steadily rise but the value per cow stays the same; extensive cattle ranching is a product of a bygone culture. A child

of the cattle monoculture, the rancher's automatic reaction is to shift to a new and fashionable monoculture: trees. There seems to be no friction with instincts and surroundings if one farms seedlings instead of calves. But it is easy to forget that we have centuries of research and tradition to help us with the diseases of cattle, and this introduced animal quite mercifully has left much of its fauna of diseases — e.g., hoof and mouth disease — outside of Costa Rica, to date.

So we have thousands of hectares of planted young native trees in Guanacaste Province, with tens of thousands more on the way, and not a single Costa Rican forest entomologist. There is not a single person studying the many species of wild insects that are going to appear on those trees when they are 2, 5, 10, and 20 years of age. Today is the time to begin to understand those insects and what is known about them in the world at large, not when you wake up and find all the leaves stripped off 10,000 ha of 15-year-old trees. Moreover, there is not a single economist specializing in how to plan the planting process today so that 20-40 years from now the mix of tree species moving into the market do not produce a glut of cheap local wood that is of little interest to the more complex international market.

It is all well and good to note that conserved wildlands are special generators of clean water for their adjacent agricultural lands. There is, however, not a single Costa Rican competent to really bioassay a river for the amount of agrochemicals hitting that river, to say nothing about coming to understand how this fluctuates with season, zone, wildland and endpoint crop. Water rights legislation? We might as well be California in the year 1800. Who is going to run the Costa Rican Environmental Protection Agency when it finally evolves itself? It will need its lawyers and its water chemists, but above all it will need those biologically literate school children to go on for the advanced training needed to understand the biological linkage between the initial natural resource and the altered natural resource. And absentee landlording works no better with the EPA than it does with cattle reanching.

Costa Rica is a corporation, with 3,000,000 shareholders. The half million species in her greenhouses, and the capacity to manage the information about those species, are what Costa Rica initially puts on the table in any joint venture. This management is no small intellectual task. The National Biodiversity Insitute was created to work these waters. Biodiversity prospecting is here

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in full swing. Like any other kinds of mining and development, it needs a world of in-country contracts, regulations, technological development. A major part of the profit from the commercial development of the biodiversity reserves in Costa Rica's wildlands needs to pay a major part of the overhead for the 25% of the country in greenhouses and for the corporation as a whole.

And there is no better teacher about wildland biodiversity potential than the wildlands themselves. We chatter on and on about mining the shaman of a Venezuelan village for his ethnobotanical knowledge; we need to speak his language to do so. Well, if we back off and learn the language of the forest in the first place, we discover quite quickly that there are far more shamans from whom to learn than those called *H. sapiens*. Simple natural history leads quickly to the seed rich in alkaloids, the antibiotic fruit, the water-soluble superglue.

Good Fences Make Good Neighbors

An important step towards the conservation of the wildlands from being a picture on the wall to being a major crop in the agroecosystem is to reach agreement about the boundaries of each particular wildland. Society has to know where the boundaries are and why. It can be handed down to society as an arbitrary decision by bald graybeards, or the society can be sufficiently biologically literate to understand why this swamp is in the national park, and that one is converted to rice. The local society needs to know why one large block of rainforest is better than ten little blocks of rainforest, why poaching a tapir in a national park is an act against society, and why raising a tapir for the table is just ranching. It needs very much to know why the federal taxes from a sulphur mine in a pristine river do not compensate the national budget for the loss of that river.

We are equipped with centuries of traditions about how to regulate, control, approve, consider, and evaluate the relative placement of rice, cotton, cows, peanuts, etc. Even tree crops have a certain history. However, the understanding of the relative siting placement of wildlands is a closed book to the average citizen, and written in an odd language as well. The book is firmly glued shut when we consider the placement of wildlands for real production — biodiversity conservation, ecotourism, water resources, seed stocks, biological literacy, recreation, etc. And

perhaps most difficult of all, national planning of the placement of wildlands cannot be flipped on and off, and back and forth, as can decisions about other kinds of crops. A farm can be cattle pasture for two years, a cotton field a year later, an airstrip the next, and peanuts for the next decade. Yes, the regeneration of rainforest is possible, under a variety of circumstances, but it takes time, lots of time. It takes hundreds to thousands of year to regenerate a tropical forest to something approaching primary forest. A wildland biotic factory cannot go bankrupt now, and be rebuilt in another site a decade later.

Intellectual Development and Population Size

No amount of clever management of natural resources of Costa Rica will save the country from being an impoverished slum if the number of consumers is not fine-tuned to the carrying capacity of the country's resource production. This fine-tuning demands, among other things, a varied and complex understanding of cause and effect, of acts and consequences by the populace itself. In theory, Costa Rica could learn by trial and error. But regrowing tropical wildlands, replacing ecosystems, regaining topsoil, etc., is not minor and quick tinkering.

This needed understanding for fine-tuning must appear, and appear rapidly. Comparative biology, taught in wildlands with wildland organisms, is an extremely powerful effective instructor of cause and effect. The forest lives it. The mouse density rises, the predators appear and eat them. The rainy season starts late, all the leaves are lost. The ant-acacia loses its mutualist ants, the acacia dies. The leaf with no chemical defenses gets eaten. The starving bird can feed one young well or three poorly. These processes — and many more — teach real economics, mutualism, parasitism, contractual relations, etc.

If the Costa Rican individual, rural or otherwise, is to move through a reduction in population in the direction of greater individual value and performance, this process demands a profound knowledge of cause and effect. This process also requires rewriting the social contract. Individual consumption needs to float around a level whereby the smarter, the better trained, the variously advantaged, do not lock up the full opportunity in the 1-2 decades during which those being upgraded are getting there. Creating a Costa Rican populace that is in full charge of it-

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self is not going to happen overnight. Does the irrigation water coming from a conserved wildland just result in one rice farmer having two airplanes instead of one, or does it mean that the children from ten families can get a university education instead of just those from one? Do the antibiotics discovered in a plant in one Costa Rican national park increase an international corporation's annual dividends by 2%, or do they mean that the park can hire the biologists to be teachers so that 30,000 school children can spend five more days year exploring the intellectual offerings of the national parks near their schools? These are real choices, choices that a biologically literate populace is likely to make correctly.

The production of another human being is an act of enormous individual and social responsibility. It is perhaps one of the most careless events still occurring in Costa Rica. We watch where we drive. We keep poisons out of the hands of children (why only children?). We invest huge amounts in health advances. We insure ourselves into old age. We work ever so hard to squash our instincts to kill those humans who trespass against us. And we blithely dump yet more and more and more and more consumers into the habitat. And every new consumer is a lifetime investment. Yes, we are hard-wired for it. But we all know that it takes a special effort to override other hard-wired emotions, and the drive to reproduce is not exempt.

Voluntary Reduction of Family Size

If you ask a 30-year-old Costa Rican member of a 12-child family why he or she has only two children, the reply is very straightforward: "Because I want many things for each of my children, and my income is not enough to provide that for many children." All around us in rural Guanacaste we observe consumer desires as the driving force for the reduction in family size. This is family reduction with a carrot rather than a stick. Before admonishing the selfishness and materialism of this desire for many things, note that the "many things" are just those things that all members of the developed world view as normal middle-class possessions. Attendance at school through university, good medical services, good clothing, good food, a bicycle when young, a radio and TV, books, binoculars, a camera, etc. We are not talking about a yacht in a marina.

What is peculiar about the Costa Rican environment that has generated people to begin to adopt on their own such a policy?

1) The per capita income is low, but still high enough that an individual who makes the above decision can in fact convert the cost of barely raising 10 children into two children plus bicycles, etc.

2) The widespread grade school education of the entire populace has generated an awareness of this type of cause and effect.

3) The comparatively good medical regime in Costa Rica has rendered the probability of child death fairly low (e.g., 1986, 15.2/1000 infant mortality in Costa Rica as compared with 10.4/1000 in the US); the parental investment is relatively safe.

4) The technology for planned family size has been freely available across the counter and in clinics for two decades.

5) Costa Rica's legislation-rich society has led, among other things, to the extremely rapid disappearance of the lawless frontier in which someone (especially an uneducated person) can imagine that there are as yet uncolonized frontiers in various directions. The ordinary Costa Rican is coming to see a conserved wildland as a kind of explicit land use, a crop, rather than the edge of the frontier. The country is so small that one cannot dream of the uncolonized "over there". You and your friends can go visit and discover that anywhere you go someone already owns the land.

6) The pleasures of the developed world are staring you in the face everywhere you turn. They are often beyond your immediate income, but not so economically distant that you cannot imagine them being yours.

7) Being a nation of immigrants, Costa Ricans are proud, but not so proud that they find the importation of ideas distasteful. Neither national parks nor refrigerators are home grown in Costa Rica, any more than they are in the US.

How Do Two Raise a Small Family?

We largely learn how to be parents by how we are treated by our parents. Our rural neighbors in Guanacaste have moved from 8-15 child families to 1-3 child families in one generation. When you have only 1-3 children, you are desperate to have the

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best for each and to insure that each survives. But what you know about child-rearing comes from your childhood, a childhood in which little was invested in each of many children. You want the best health, the best school, the best clothes, the best opportunities. But you have no idea what actually are the best, nor how to identify them. Worse, your income does not allow you access to most of what you may identify as "the best". What you most need is a counseling system that helps you answer these questions within the realities of your immediate working and social environment. Some Guanacastecos have left behind their beautiful countryside to immigrate to a city slum so that their children can go to "better" schools. Ironically, it is their very rural naiveté that allows this to occur. The bright lights of the city are not the bars and stores, but the dream of a bilingual grade school and a medical clinic that is open on Saturdays and has a functional ambulance.

STORY FOUR. OVERVIEW

Minute Costa Rica

Much of Costa Rica's recent success is due to her small size, as is her chance for future survival.

1) When Costa Rica trashed her countryside, she could not blame any one person or other political force. The Contras did not cut down Costa Rica's trees, and the Japanese did not buy them. Her middle class merchants, farmers and lawyers removed them for about 100 different reasons. Furthermore, her generally educated population is quite aware enough of market forces and ownership patterns to know that they are their own worst enemy.

2) Costa Rica's affected populace cannot emigrate to some other area to recuperate. If the US had been the size of the dust bowl, we would not have had to wait until the 1970's for the Environmental Protection Agency. There is no Brazilian northeast or Amazonian escape in Costa Rica.

3) Costa Rica is hooked on becoming a developed world country, and all the personal nice things that implies. When the hydroelectric dam silts in and electricity prices skyrocket or electricity is rationed, it hits your new electric refrigerator hard. And

you can see very clearly the deforested watershed above that hydroelectric dam — it is only a few hours' drive away, no matter where you live.

4) A country that loves to import consumer good — movies, cars, computers, etc. — also imports the worries and reasoning of developed-world environmental debates. The messages of Earth Day 1970 were not lost on Costa Rica. *Silent Spring* marches as readily across a tropical orange orchard as across a Wisconsin woodlot. The temperate regions bemoan the reduction in density of our migrant songbirds, and Costa Ricans read the newspapers — and know that those birds are (were) spending their winters in Costa Rica. The forest clearing and pesticides in rural Costa Rica, so threatening to migrant birds, are only ten minutes away from the urban capital, and almost without doubt occur on the family ranch or farm owned by virtually every Costa Rican legislator and politician. Study a successful Costa Rican and you find rural production, conducted with some elements of the frontier.

5) Three million people can think together — many cities do it. It is no accident that virtually the entire adult population votes in the presidential election.

6) When a challenge arrives, it is not too hard to call together the village elders. They are all related associates, and all live within an hour's drive of each other. One plane from Miami can quite accidentally contain the President of the Central Bank, the environmental advisor to the President of Costa Rica, the Minister of Education, and an old man coffee farmer who knew all their fathers. The most amazing discussions occur at the gate. The father of the President, who is being sworn into office as this essay is being written, established Costa Rica's Social Security system and the University of Costa Rica, and formed a coalition of the Communist labor unions and the Catholic Church as his primary political base. Ability to mobilize the nation is a virtue, especially when the enemy is no bigger than yourself.

The Church as an Ingredient in the Reconstitution of Costa Rica around the Management and Planning of the Use of its Natural Resources.

The Catholic Church in Costa Rica is one of the most influential of the major embodiments of social rules for the functioning of Costa Rican society.

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The Church here, as elsewhere, is confronted with the question of whether it will disappear along with the poor, or whether it will become a major player in the process that elevates the poor to middle-class incomes. It is confronted with the option of playing an important leadership and organizational role in this inevitable process. In other words, is the Church to be viewed as a party that specializes in the provision of eternal hope to those who can have no hope in the present world, or can it be a leader in the pursuit of real hope?

The Church can play a crucial role in the act of bringing Costa Rica into harmony with her human and natural resources. Since the Church touches on all aspects of life, its total potential impact is profound and wide-ranging. The goal of alleviating human misery and offering hope is very much in line with Catholic teaching. The Church has trained the social consciousness of many of the most committed and ethical Costa Ricans. This is a large block of the most valuable potential doers and problem solvers. Many of these individuals have refrained from working with all their energy on the solutions to environmentally-related poverty because of their somewhat confused perception of Vatican teaching in the area of the relation of man to his environment. A strong message of encouragement from the leadership of the Catholic Church would liberate, as well as encourage, the strengths of these most honor-bound Costa Ricans.

The religious network long spread across Costa Rica's geography and society could be extremely important in the educational process of bringing each and every Costa Rican to know what is the real carrying capacity for consumers at the national and local levels, and awakening public understanding of the consequences of not understanding this capacity. Of equal magnitude is the task of bringing people together to publically accept the significance of the consequences for this country — a country with no new frontier to migrate to, with no hidden reserves to discover other than its own unused human resource.

The Vatican is already showing signs of a strong start. In 1989 His Holiness stated: "It is a requisite of our human dignity, and therefore a heavy responsibility, to exercise dominion over the created world such that it may truly be for the enjoyment of the human family. The exploitation of the riches of nature must happen according to criteria that take into consideration not only the present needs of people, but also the needs of future generations... Progress in the field of ecology, the growing awareness of

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the need to protect and conserve limited natural, non-renewable resources, are in harmony with the demands for a healthy governance. God is glorified when the created world serves the needs of global development of the entire human family."

Costa Rica as Pilot Project

Reflection on the small size of Costa Rica brings to mind the frequent temperate zone criticism that Costa Rica is a peculiar situation and therefore not applicable to the bigger, or more frontier, or poorer, or more trashed, or... other tropical countries. When the Wright brothers decided to fly their first airplane, they did not pick a January day in a Canadian blizzard. Get the plane in the air, and later we can add the design features that enable flight in hurricanes, and social features that allow huge airports in metropolitan centers.

Costa Rica's conspicuous role, and her possibility for survival on an international stage, is to be a pilot project from which other tropical countries can gain ideas, inspiration, and on occasion, direct training. Most jet fighter pilots first flew in a Piper Cub. This means once again that Costa Rica needs to put a premium on the development of her human intellectual resource. In sheer bulk — whether biodiversity content, agricultural production, or political clout — she is too small to have a chance. There is more conserved wildland in the drainage basin of one hydroelectric dam in Venezuela than in all of Costa Rica. There are far more species of organisms in Peru, Bolivia, or Colombia than in Costa Rica. Costa Rica's future lies in being quick, ahead, and light on her feet.

The "poor" and "peasant science" have not played a prominent role in this essay. There is no gene for "poor" nor for "peasant". Both are social processes and consequences. The intellectual development of the rural environment and the sustainable development of agroecosystems do not demand nor mandatorily generate either concept. Both poverty and peasants do still exist in Costa Rica, and both are headed for extinction. Ethical development of the agroecosystem recognizes that human destiny is not picking beetles off bean bushes in the hot sun, nor hand-picking weeds out of rice fields. The Australian tropics is not a seething agroecosystem only for the reason that the Australian populace demands a middle-class standard of living

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or better. Its soils, sun and services are not different from those of other densely populated lands only a short distance away. By no religious principle should tens of thousands of humans become human draft animals so that tropical Australia can become a seething agroecosystem. There is more than wilderness to be said for the absence of humans.

When confronted with large numbers of rural poor and peasantified humans in the past two decades, there has been a strong urge to reinvent the millenia-old wheels of peasant science. Yes, of course, there are a multitude of labor-intensive ways to increase agricultural production from tropical lands. Why? Shall we also reinvent humans as domestic meat animals, enormous armies of expendable soldiers, and massive starvation in response to fluctuations in rainfall? More than biological literacy needs firm support in the development of the tropics. It was once written that those who ignore history are destined to relieve it.

Zero or negative population growth is a necessary but not sufficient aspect of the final adjustment of the human consumer to its resource base. It is evident that countries approaching zero population growth do not instantly and automatically clean up their environmental interaction. Europe stands as a sparkling example. But the wheels of social change do grind, if slowly. Europe is a colossal social machine whose soft and hard wiring is excruciatingly difficult to alter. The seedlings of internal adjustment exist all over the surface. The crumbling of the Berlin Wall was not some miscellaneous social blip. It is no accident that the Vatican has organized this workshop — in a country both massively Catholic and with zero population growth in 1985. Concern about acid rain was not invented in New York but in Scandinavia. Most of the European cave paintings are now permanently closed to the outside. Sweden has been the largest single international contributor to the financing of the explosion of Costa Rican efforts to integrate traditional conservation with Costa Rican society.

Countries approaching zero population growth do not automatically reduce their per capita consumption so that more production flows into poorer, and more populous countries. Why should they? Rather, they focus their attention on further reduction of their own populations, increasing the distribution of income to the lower income brackets, and greater productivity for themselves. The unification of Europe, both through the Euro-

pean Community and the current joining of the East and West are evident steps in these directions.

The real jolt to developed countries will come when the developing tropical countries become equal trading partners. When Costa Rica converts herself from farm for the US to trading partner, the market price of Costa Rica's produce will increase notably. This price increase must be matched by a quality increase if Costa Rica is to be anything other than a poor village. And that quality increase requires the development of Costa Rica's wildlands as a major crop, a biologically literate population, a consumer populace that is fine-tuned to the carrying capacity of the country, and a country whose national natural resources are managed as a unified whole. *That* is the ethical treatment of Costa Rica's species and habitats.

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