In Search of Nature: Imagining the Precolumbian Landscapes of Ancient Central America

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Not all the winds, and storms, and earthquakes, and seas, and seasons of the world have done so much to revolutionize the earth as Man, the power of an endless life, has done since the day he came forth upon it, and received dominion over it (H. Bushnell, cited on the title page of Marsh 1885).

The work of literary scholars, anthropologists, cultural historians, and critical theorists over the past several decades has yielded abundant evidence that "nature" is not nearly so natural as it seems. Instead, it is a profoundly human construction (Cronon 1995).
There are no virgin tropical forests today, nor were there in 1492 (Denevan 1992b:375).
They took all the trees and put 'em in a tree museum. Charged all the people a dollar and a half just to see 'em (Joni Mitchell, "*Big Yellow Taxi*").

Introduction

In this paper I would like to address what I perceive as a problem in the construction of the definition and study of "nature". Environmental historian William Cronon has noted:

Ideas of nature never exist outside of a cultural context, and the meanings we assign to nature cannot help reflecting that context. The main reason this gets us into trouble is that nature as essence, nature as naïve reality, wants us to see nature as if it had no cultural context, as if it were everywhere and always the same" (Cronon 1995:35).

One does not have to read far into textbooks of ecology spanning a century of scholarship to learn that the term "ecology" comes from the Greek oikos, meaning "home" or "abode" (Clements 1904:1, Ricklefs 1990:3). However, the specific interpretation of this etymology is revealing. For many ecologists, the "home" with which ecology is concerned refers to the habitat of plants and animals. Ecology is concerned with the oikos of a tree, a bird, a frog, a wolf, or indeed all of these together. Humans, generously, are not excluded from this definition. However, the Greek term was almost certainly anthropocentric, referring specifically to the abode of humans. When looking at the ecological literature, it does not take long to realize that the oikos of humans has not been the central focus of the discipline. In fact, the oikos often comes across almost as one in which humans are not even welcome. This is exemplified by the following statement by George Perkins Marsh (1802-1882) the ideological predecessor of modern environmentalists, whose book *Man and Nature, or Physical Geography as Modified by*

Human Action (1864) concentrated on the deleterious effects on the balance of nature by the actions of humans:

… man is everywhere a disturbing agent. Wherever he plants his foot, the harmonies of nature are turned to discords. The proportions and accomodations which insured the stability of existing arrangements are overthrown (Marsh 1885:33).

Environmentalist literature emphasizes the importance of this home for human existence, and how critical it is for us to conserve and sustain it in order to survive. However, the analogy is only carried so far. What is missing is the realization that the oikos was constructed by humans as a place for them to dwell. The oikos is not a temple, but a residence. What makes a "home" different from a "house"? For me, it is evidence that someone has been living there, and lives there still.

Why then, has human presence come to be interpreted as violation, disturbance, disorder, and pollution? An environment in which there is no discernable evidence of human activity (which does not necessarily mean it is not there…) is described as "virgin" and "pristine". In the instant that a foot makes an impression in the soil, something has been "disturbed". A natural environment without humans is "clean" and "undisturbed". It has also, in relatively recent times, come to be understood as good and moral. "Pollution", on the other hand, is bad and immoral. It not only means to make something foul or unclean, but it removes purity. Since nature without the touch of human hands is pure and clean and moral, pollution can only be produced by people. A volcano can belch thousands of tons of acidic gases into the air, but few environmentalists would call this "air pollution". A red tide, despite the smell produced by decaying sea life, does not "pollute" the water. There is no question but that language both reflects and conditions the way we think about the relationships between humans and their environment. This is especially manifest in the use of the term "impact" to describe the evidence of any human activity, intentional or unintentional. I would prefer a more accurate, less loaded term, such as "alteration".

To a certain extent, arguments for the existence of nature are like the old adage about the sound of a tree falling in a forest if there is no one there to hear it. We know that the planet was here long before there were humans. This is a model that is alluded to even in Genesis. However, I suspect that the idea of nature as separate from humans is a relatively recent concept, and one peculiarly Western. It would almost certainly have been alien to ancient Sumerian or Egyptian thought as recently as four thousand years ago. I doubt that it entered European consciousness until after the spread of the Holy Roman Empire and the extirpation of the ancient pagan traditions under Christian missionization. As has been made clear in recent arguments from a Native American point of view, it is still foreign to many. As anthropologist Roy Ellen has noted, "… humans modify the world around them on an enormous scale, and have done so through co-evolutionary interactions for many thousands of years. Effectively, all landscapes with which humans routinely interact are therefore cultural: and our environment is every bit as much as what is made socially as what is not" (Ellen 1996:14).

An even more recent invention is the Enlightenment concept of nature as something good, moral, and aesthetic. Taken to its extreme, man's harnessing of nature was for some Victorian thinkers the greatest moral achievement. Consider the utopian vision of Alfred Russell Wallace, Darwin's partner in the articulation of the the theory of natural selection. Wallace felt that human culture was so distinct that humans were exempt from natural laws, and indeed allowed culture to almost entirely supplant nature.

Here, then, we see the true grandeur and dignity of man. On this view of his special attributes, we may admit that even those who claim for him a position and an order, a class, or a sub-kingdom by himself, have some reason on their side. He is, indeed, a being apart, since he is not influenced by the great laws which irresistibly modify all other organic beings. Nay, more: this victory which he has gained for himself gives him a directing influence over other existences. Man has not only escaped natural selection himself, but he is actually able to take away some of that power from nature which, before, his appearance, she universally exercised. We can anticipate the time when the earth will produce only cultivated plants and domestic animals; when man's selection shall have supplanted natural selection; and when the ocean will be the only domain in which that power can be exerted, which for countless cycles of ages ruled supreme over the earth (cited in Lubbock 1869).

This may seem to be naïve and archaic, but it has been echoed in the more recent work of Stephen Jay Gould (1979), who suggests that cultural evolution may be Lamarckian rather than Darwinian.

I would like to argue that the present "nature" of the Holocene epoch is one from which humans cannot be removed, and that the notion of Holocene environments in which humans are infrequent (and unwelcome?) visitors are as artificial as Victorian gardens- and perhaps just as elitist in conception. It is not a question of nature vs. humans, but of just what role culture will continue to play in altering the garden in which we dwell. Wallace's vision was flawed, but not necessarily with regard to the domestication of the world. His mistake was in underestimating the power of natural selection, whose effects we cannot change or predict, on culture as a part of nature.

Deep Nature/Shallow Culture

Given the conception of oikos as a home for humanity, it is particularly ironic that the notion of "deep ecology" does not refer to the study of those ecological systems in which humans have been present for the longest period of time, but exactly the opposite. The idea of humans coming into natural areas is an ancient one. The archetypal model is the Garden of Eden, and we know what happened there. It is true that human presence represents but an instant in geological time, and in the ever-increasing eons of biological time. However, three and a half million years of bipedal hominids is not an insignificant chunk of time, especially when one considers the significant changes the planet has experienced during the same period. The first stone tools date to about two million years ago, which also represent the first recognizable permanent human "alteration" of their environment. That their presence left a lasting impression is evidenced by the existence

of the archaeological record itself. In fact, were it not for permanent human alteration of "nature", archaeology could not exist. However, archaeology is not the study of the oikos, but its residents themselves. The environment is incidental to the study of human culture. This is a gap that I see in our understanding of culture-in-nature that has been perpetuated by the culture/nature dichotomy. Whether modern *Homo sapiens* or an archaic ancestor, humans were part of the ecosystems in which they lived. They had direct effects upon trophic levels and the flow of energy. Neither ecologists nor archaeologists have been addressing the evolution of a "nature" in which humans have been firmly and undeniably an element for the past two million years. The systematic exclusion of a 40-50 kg carnivorous mammal, especially one with the special capabilities of humans, is a significant oversight. In imagining past landscapes, one cannot pretend they were not there.

The spread of human populations began sometime around two million years ago, when successful cultural adaptations allowed members of the genus *Homo* to occupy several different niches in East Africa. By a million years ago, humans had spread to southern Europe, India, Indonesia, and China. By at least a quarter of a million years ago, they were present in Great Britain and Central Europe.

Archaeologists and anthropologists have been largely culpable for the notion that early humans had an insignificant role in environmental change. For example, Karl Butzer writes "Man-land relationships during the early Pleistocene were… one-sided, with the hominid populations but a minor ecological factor in their environment." He notes that *Homo erectus* "lacked the technology and numbers to modify the environment in any significant way" and says that "it is improbable that any appreciable, large-scale influence was executed on the natural vegetation during the course of the middle and early Pleistocene."

It is hard for me to imagine an ecologist claiming that wolves, rabbits, or termites were "a minor ecological factor" or that they have no appreciable influence on their environment. What would happen if any one of these were simply removed? What Butzer means by "modification in a significant way" is undoubtedly linked to the notion of cultural influence and the culture/nature dichotomy, not the concept of humans as *part* of natural systems. Humans on the landscape competed with other scavengers, foragers, and hunters. They also contributed distinct patterns of selection and energy flow. The most tangible evidence that we have for their alteration of the environment is the transformation of chunks of fine-grained stone into handaxes, cleavers, and countless waste flakes. However, if we know that humans are present, and have an effect (unmeasureable as it may be) can we continue to speak of "nature"?

Even if human "alteration" of the environment was minimal for the first million years, the potential for profound effects changed rapidly shortly thereafter. The earliest evidence for human use of fire remains elusive. One of the best candidates is the site of Chesowanja, where the association of fire with ancient human tools suggests non-accidental conflagrations at about 1.5 million years ago (Gowlett et al. 19??). Even if Chesowanja can be attributed to lightning strikes, there is still evidence for human use of fire by at

least half a million years ago. At Zhoukoudien, near Beijing, stratified levels in cave deposits indicate a regular use of fire, probably for warmth and food preparation, by 430,000 BP. Other sites from this time period with definite evidence for human use of fire include Torralba-Ambrona (Spain), Terra Amata (France), Vertesszollos (Hungary), and Westbury-sub-Mendip (England), all dating to around 400,000 BP. From Great Britain to China, from Hungary to Cape Horn, people were fanning flames. As noted by the authors of a recent text on wildland fire, "Since the mid-Pleistocene… the story of fire has been largely the story of the genus *Homo*… The earth as fire planet evolved into the earth as hearth" (Pyne et al. 1996:604).

I will treat the use of fire in more detail later in this paper. Suffice it to say that fire was not used only for keeping warm. It was effective for driving game, but may have been even more important for initiating and maintaining successions in plant and animal communities that were advantageous to human subsistence. Needless to say, human-induced, post-fire successions had a profound effect across whole ecosystems. They were probably sustained for half a million years over large portions of Africa, Asia, and Europe in both grasslands and forests as the principal method for "domesticating" the landscape.

Fire was both the cause and effect for the fact that humans preferentially lived where burning was possible and shunned unburned regions as uninhabitable, that the nomadism of hunting and gathering societies was intimately interdependent with a cylce of growth and regrowth that was itself contingent on a cycle of burning. To a remarkable extent humans were able, through fire, to shape wholesale the environments in which they lived, to render that land accessible (Pyne et al. 1996:611).

These techniques became less important with the advent of agriculture, whose distinct orientation may have actually reduced the usage of fire in areas where it previously had been regularly applied. Given that agricultural techniques were being used in parts of the Old World by 9000 years ago, and were widespread from Europe to Asia by at least 6000 years ago, it is hard to say whether we can detect the traces of hundreds of thousands of years of pre-agricultural, fire-managed landscapes. However, it is hard to imagine that these did not affect the evolution of other species. With the exception of small islands (it now appears that Australia may have been occupied by 100,000 BP), large deserts, high mountain ranges, and glaciated areas, by the end of the Pleistocene in the Old World there were few landscapes where one could be sure to find "nature" without humans in it.

Archaeologist Paul Martin and others have suggested that one of the most significant effects of human presence in both the Old and New Worlds during the late Pleistocene was the extinction of large game animals (Martin 1966, 1984; Martin and Wright 1967; Martin and Klein 1984; Meltzer and Mead 1983; Mead and Meltzer 1985). Although this hypothesis had fallen out of favor, primarily because large game extinctions appear to have been accompanied by extinctions of songbirds, rodents, and other species unlikely to have been anthropogenic, it has recently received renewed support. Human overexploitation of megaherbivores may have resulted in vegetational changes that in turn affected other species (Owen-Smith 1987, Lister and Bahn 1994). "If hunters enter

an area and specialize on one species of herbivore, then the local carnivores which also concentrate on the same prey will be starved out during winter competition and become extinct. The prey species then expands in numbers and territory and puts pressure upon the numbers of other herbivore species, in turn causing other carnivores to become extinct" (Simmons 1989:76). Furthermore, Daniel Fisher, a geologist at the University of Michigan, has found that late mammoth tusks from the Great Lakes region show no evidence of dietary stress. He suggests that the species did not starve to death, but was hunted to extinction.

It should be noted that late Pleistocene hunters may have wasted huge numbers of animals that were not utilized. It is estimated that the portion of the Horner bone bed site in northwestern Wyoming excavated in 1949-1952 contains the remains of at least 200 bison (Jepsen 1953), 158 of which are well documented (Todd 1987:236). The Jones-Miller site in eastern Colorado had nearly 300 animals (Todd 1987:239), utilized in two episodes. However, Lawrence Todd points out that there is evidence for butchering on only a small number of these animals.

Holocene Coevolution

Archaeologist David Rindos (1984) has applied the term coevolution to the unconscious relationship between humans, plants, and animals that results in simultaneous changes among all of them, eventually resulting in the domestication. Humans had occupied virtually all habitable (and many only marginally habitable) parts of the globe by the end of the Pleistocene. It is true that people were relative latecomers to the New World. However, given the timing of the peopling of the Americas, there are no modern environments into which humans "came" (bringing disturbance, etc.). Humans were already here by the end of the Ice Age. According to the archaeological evidence, humans had established a pervasive presence from Alaska to Tierra del Fuego before the end of the Pleistocene. This presence included biomes ranging from tundra to tropical forest, from sea level to altitudes of 4000 m. One of the newest contributions to this picture is clear documentation for human presence in the eastern Amazon basin by 11,000 BP (Roosevelt et al. 1996), by people who knew how to hunt and light fires. Therefore, the emergence of Holocene environments in the New World was a coevolutionary process. While it is true that people migrated into "pristine" Pleistocene niches, humans did not come into Holocene environments from the outside, bringing with them change and disturbance. Rather, Holocene ecosystems evolved with humans *already in them*, playing at least as vital a role as any other organisms. If we seek a "nature" without humans in the Americas during the past 10,000 years, we cannot find it.

Unfortunately, the illusion of vast continents devoid of humans is an accident of history. Epidemic diseases devastated Native American populations, in some cases racing well ahead of the European explorers themselves. Geographer William Denevan has recently estimated the total population of the New World before the arrival of Europeans at 54 million people. This figure was reduced by 89% in the first century after initial contact with Europeans. It has been reported that in areas of Amazon forest that have been altered by slash-and-burn agriculture, it takes 60-80 years to recover species diversity and 140-

200 years to recover lost biomass (Saldarriaga and Uhl 1991). While this may sound like a long time, most areas of the New World had at least as long a "recovery" period before they were resettled in levels anywhere close to Precolumbian maximums. In areas of the highest rainfall, and hence the most rapid regeneration of vegetation, the effects of human presence could be blurred and largely invisible to the untrained eye within just a few years of abandonment. By 1750, the population of the New World was still only 30% of its Precolumbian total (Denevan 1992b:371). The rapid decline and slow growth of human populations provided plenty of time for landscapes that had been significant altered by human activity-and maintained as "cultural landscapes" for thousands of years--to *appear* as if they had never been occupied. As Rostland (1957:409) noted, "paradoxical as it may seem, there was undoubtedly much more 'forest primeval' in 1850 than in 1650". Furthermore, even in 1850, the Pacific Northwest of the U.S. was not covered by old growth forests. A recent BLM study suggests that in 1850 only about 40% of the forests of the Oregon Coast Range were more than 200 years old (Teensma et al. 1991). The effects of 16th century depopulations and Colonial reconfigurations, not to mention Precolumbian population shifts, can still be seen today throughout most of the New World. This is especially apparent in areas that are now protected areas, such as the Calakmul Biosphere Reserve in Guatemala, that was once home to dense population centers and one of the most thoroughly "domesticated" landscapes in the Americas. Studies of the remains of Maya housemounds that were undertaken as early as the 1930s revealed that most of the Dept. of Peten and Belize were continuously settled between more dense "ceremonial centers". Slash-and-burn agriculture had been taking place here since at least 1000 BC, and the fuel needs of lime plaster production, ceramic manufacture, and daily cooking had been constant and increasing for just as long.

One of the most dramatic examples of the "regeneration effect" is the Biltmore Estate in Asheville, North Carolina, arguably the birthplace of modern forestry (Spirn 1995). Photographs of the area taken in the late 19th century, before Frederick Law Olmstead's landscaping, show a blighted landscape of small, secondary-growth forest. Today the Pisgah National Forest is a rich, mature forest that would be an inspiration to any environmentalist, thanks to the understanding by Gifford Pinchot (the first director of the U.S. Forest Service) that "trees could be cut and the forest preserved at one and the same time."

Fire, the principal instrument of environmental alteration in the Pleistocene, continued to be effective through the Holocene. It served to create and maintain grasslands such as the prairies that once extended into Ohio and the western portions of Pennsylvania and New York (Pyne 1982), including a grassland of 1000 square miles in the Shenandoah Valley (Van Lear and Waldrop 1989). One author notes that these eastern prairies "would mostly have disappeared if it had not been for the nearly annual burning of these grasslands by the North American Indians" (Anderson 1990). That this activity had far-reaching effects on the ecology is exemplified by reports of bison as far east as Massachusetts (Williams 1989). In fact, a significant incentive to the use of fire was the fact that it increased frequencies of berries, fruit and nut trees, and populations of animals such as deer, turkeys, and grouse that preferred open or forest margin habitats.

Native use of fire was not only used for creating and maintaining grasslands, but for altering the ecology of temperate forests. I can only summarize the vast literature on this topic, which indicates that fire played a key role in periodically clearing forests of undergrowth whose flammability can endanger the forest's very existence if allowed to go too long without burning. Andrew White, who explored the Potomac Valley in 1633, noted that the Virginia forest "is not choked with an undergrowth of brambles and bushes, but as if layed out in a manner so open, that you might freely drive a four horse chariot in the midst of the trees" (Williams 1989). In New England, Roger Williams recorded that the Indians set fires twice a year, writing that "this burning of the Wood to them they count a Benefit, both for destroying of vermin, and keeping downe the Weeds and thickets" (Cronon 1985). This "disturbance" and "impact" of regular human activity was actually healthy for the forest as a whole, resulting in greater overall stability. The more "densified" forests that have resulted from the cessation of regular, low-level burning are "decidedly more ecologically unstable that the ones they are replacing, i.e. more susceptible to insects, disease, drought, and catastrophic fire. When fires do occur in such forests (as they inevitably will), they will be intense, stand replacing, soil damaging fires, beyond that which would have been typical in pre-European forests" (MacCleery n.d.)

The use of fire was was hardly limited to dry grasslands and temperate forests. Tropical forests will also burn, as evidenced by the conflagration of five million hectares of lowland rain forest in Borneo in 1983 (Leighton and Wirawan 1986) and rainforest fires in the Amazon basin (Sanford et al. 1985, Saldarriaga and West 1986, Fearnside 1990). "Almost everywhere we go in Latin America, and Asia and Africa, we find charcoal buried in the soil. People have in one way or another cut and burned almost every place in the tropics" (Robert Sanford, quoted in Yoon 1993). Denevan (1961, 1992) suggests that Precolumbian fires were responsible for the eastward spread of pine forests in Nicaragua and other lowland pine forests of Central America, the Caribbean, and Mexico. "The Nicaraguan pines are fire tolerant once mature, and large numbers of seedlings survive to maturity if they can escape fire during their first three to seven years. Where settlement has been abandoned and fire ceases, mixed hardwoods gradually replace pines" (Denevan 1992b:372). At the La Selva Biological Station in northern Costa Rica, archaeological excavations in an area of "virgin" forest yielded charcoal deposits from slash-and-burn agriculture over a period of at least a thousand years (Quintanilla 1990, Horn and Sanford 1992, Yoon 1993). Charcoal with Precolumbian dates from sediments in a high altitude lake in Costa Rica has also been interpreted as possibly resulting from human activity (Horn and Sanford 1992:357). Agricultural burning in rain forests of Costa Rica and the Amazon basin (cf. Hamburg and Sanford 1986) "may have affected species patterning and perhaps contributed to the maintenance of overall community diversity" (Horn and Sanford 1992:357). As fire ecologist Stephen Pyne (1982:46) noted, "the virgin forest was not encountered in the sixteenth and seventeenth centuries… it was invented in the late eighteenth and early nineteenth centuries."

Although fire was arguably the most significant tool for environmental alteration, the use of wood also had significant effects. Archaeologist Kenneth Ames (personal

communication, 1996) has been working on estimates of wood requirements for ancient plank houses constructed in the Pacific Northwest. Using data from the excavation of one such structure in Portland, Oregon, he estimated that a single house that probably housed between 40 to 80 people would have required 50 cedar logs and the equivalent of 55,000 to 75,000 board feet of lumber. While small, single family homes would have required as little as 6000 board feet, larger structures were built that required over 100,000 board feet of lumber. The estimated use life of these larger houses was about 400 years. With regular replacement of cedar planks and small posts every 20 years, a single structure could have required a over a million board feet of lumber. In 1806, Lewis and Clark estimated a population for the region of 3000 people. When one considers that there is evidence for the use of plank houses in the region for over 2600 years, and adds in the amount of wood used for regular cooking, heating, dugout canoes, and manufactured implements the amount of lumber used is truly impressive.

Evidence from pollen studies and packrat middens suggest significant changes in Holocene vegetation, most notably a drastic reduction in the extent of pinyon and juniper forests after about AD 700. Betancourt and Van Devender (1981:658) noted that:

Although our present data are insufficient to establish the exact timing of woodland reduction, we postulate that marginal stands of pinyon and juniper could not withstand the relentless woodcutting needed to meet fuel demands of a growing population over the span of two centuries. Depletion of fuelwood and other local resources probably intensified the reliance on commodity imports from peripheral communities. The resulting political and economic instability may partly explain eventual migration of Chacoan peoples to the northern Rio Grande and elsewhere after 800 years B.P.

This depletion of forests in the Southwest had a permanent effect, that has persisted up to the present. In other areas, forest recovery may have hidden earlier damage. Hough (1923:54) notes that it "has happened often in many parts of the world that towns located with regard to accessible wood fuel have been forced to remove to another location when the wood was exhausted within carrying distance." Native Americans were not exempt. With regard to the Iroquois, "it is probable that live standing trees were systematically cut. This is probable because an Indian village used a large amount of firewood and exhaustion of the local supply meant moving the village…" and "prodigal use of firewood by the Iroquois and Delawares… suggests that they had a more substantial supply than dead and down trees and makes it likely that they would make use of all wood they could obtain nearby. Latifau's statement that the longer an Indian village was occupied, the farther the forest receded from it indicates that all trees were cut" (Day 1953:330). Other statements can be found on heavy wood use by the Iroquois (Jenness 1972:84, Waugh 1916:53), Huron (Kinietz 1940:42), Pomo (Kniffen 1939:358), and nothern Athabascan tribes (Morice 1895:184), and Plains peoples (Griffin 1977).

Imagining Ancient Central America

William Denevan (1992:369) has commented on the misperception of Precolumbian landscapes in the Americas: "The myth persists that in 1492 the Americas were a sparsely

populated wildernesss, 'a world of barely perceptible human disturbance.' There is substantial evidence, however, that the Native American landscape of the early sixteenth century was a humanized landscape almost everywhere." This evidence includes comments by eyewitnesses such as Bartolomé de Las Casas, who noted that, "All that has been discovered up to [1549] is full of people, like a hive of bees, so that it seems as though God has placed all, or the greater part of the entire human race in these countries" (cited in MacNutt 1909:314). The large and densely populated areas of Mexico and Peru are well known. Somewhat less attention has been paid to more dispersed populations that were undoubtedly known to Las Casas. Hernan de Soto, describing his expedition through northern Florida in 1539, wrote that they, "marched on through some great fields of corn, beans, and squash and other vegetables which had been sown on both sides of the road and were spread out as far as the eye could see across two leagues of plain" (Doolittle 1992).

Some of the earliest accounts of Costa Rica suggest extensive modification of the landscape. A "domesticated" landscape provides the best explanation for the apparent ease with which early explorers were able to traverse what is today still difficult terrain. One of the first of these was Gil González Dávila, who in 1522 made the first significant inland exploration of Costa Rica. Forced to make a landing at the Burica Peninsula, near the current Pacific border between Costa Rica and Panama, he led a contingent of 500 men and supplies northward across the whole of Costa Rica to an area near what is now Managua, Nicaragua. His presumed route would have taken him through the famous rain forests of the Golfo Dulce, but he reported no significant problems of passage. In 1541, Diego Guitiérrez made the first major expedition into the central heartland of the country, travelling up the Río Suerre (most likely the Pacuare/Reventazón) and crossing the mountains into the Central Valley via a route that took them near the Turrialba volcano. His expedition was ambushed and Gutiérrez was killed, but the survivors were able to flee overland from the Central Valley to the mouth of the Río San Juan. A direct route would have taken them across what is now the densely forested Braulio Carillo National Park and in the general direction of the La Selva Biological Station, where a successful escape is difficult to imagine if the area were anything at all like it is today. The first Spanish settlements of the Central Valley of Costa Rica were not undertaken until 1560, sufficient time for populations to have been swept by epidemic diseases and for many of the areas previously under cultivation to "recover. It has been estimated that the peak Precolumbian population of Costa Rica was 400,000 (Denevan 1992a:291), reduced to 80,000 by 1563 (MacLeod 1973:Fig. 32). However, later expeditions such as Juan Vázquez de Coronado's 1563-64 trip from Cartago to the Térraba Valley, across the Talamanca range to the Valle de la Estrella, and then back to the Central Valley, not to mention Perafán de Rivera's reverse version of the same journey (with his wife and children) in 1570-72, were probably facilitated by travel through territories that remained populated and had not yet regenerated to tropical forest.

Costa Rica provides an interesting case study for examining human/landscape coevolution from the beginning of the Holocene to the 16th century. The first evidence for human presence dates to the Paleoindian period, around 10,000 BP, and evidence for continous occupation from at least 1000 BC to the present has been recorded for most of

the major archaeological areas of the country. A recent compilation of a master registry of archaeological sites in Costa Rica provides some insights into the magnitude of Precolumbian occupation and its potential ecological influence (Vázquez et al. 1995). As of 1992, the National Museum had recorded a total of 2008 archaeological sites, the vast majority of which represent small, sedentary, pottery-producing villages. Most represent information from regional or local surveys. However, the authors of the compilation estimate that around 60% of Costa Rican territory remains archaeologically unexplored.

Paleoindian and Archaic Periods

The earliest human presence in Costa Rica is found at several sites with characteristic fluted points of the type that have been associated with mammoth and mastodon kills in both North and South America. Although there are several sites that have yielded fossilized mastodon remains, none have yet been found with clear evidence for human predation. The best-documented site is located in the Reventazon Valley, near the town of Turrialba, which incidentally appears to have been the most densely populated part of the country in latter half of the 16th century. A Paleoindian point has also been found in the Arenal Valley of northwestern Costa Rica, not far from the private rainforest reserve at Monteverde, where archaeological evidence also documents a virtually continuous human occupation for about 10,000 years. The third area with evidence for human presence at this early date is western Guanacaste, where C.V. Hartman collected a Paleoindian point (without knowing what it was) around the turn of the century. Hartman's archaeological work in the area was not far from what is now the Santa Rosa National Park, the site of Daniel Janzen's famous environmental restoration project.

The Paleoindian period and the succeeding Archaic period in Costa Rica are still largely unknown. This is in part due to the fact that populations were relatively small and sites ephemeral, but can also be attributed to the difficulty of locating sites beneath deposits of volcanic tephra and in dense tropical vegetation. Chipped stone projectile points from the Archaic period, dating to between 8000 and 2000 BC, have been found in the Turrialba Valley, the Arenal Valley, and near Monteverde in the Cordillera de Guanacaste. Inferences about human alteration of the environment at this time must remain speculative. However, there is no doubt that people were part of the ecosystem. It seems likely that they would have gravitated towards patchy, open habitats characterized by palm and fruit trees that attracted game, such as may have been created by periodic volcanic eruptions. Some of these open areas may have been maintained through use of fire.

The best hints about what may have been happening in Costa Rica at this time come from western and central Panama. Central Panama, in particular, has provided some of the most intriguing evidence for early human alteration of the tropical landscape. Piperno et al. (1991, 1992) interpret the presence of charcoal and grass microfossils together with taxa characteristic of secondary forests and disturbance in lake cores to indicate intentional use of fire for landscape modification as early as 8000 BC. Cooke and Ranere (1992:256) suggest that, "Paleoindians were probably maintaining clearings around [Lake La Yeguada], which, being one of the few large bodies of freshwater in Panama, would

have concentrated prey species." Piperno has also suggested that the earliest domestication of plants took place prior to maize cultivation and was linked to an anthropogenically-induced proliferation of successional plants in disturbed areas (Piperno 1989, 1991).

The Invention of Pottery

By at least 2000 BC, the residents of Costa Rican landscapes were manufacturing sophisticated pottery, living in wattle-and-daub houses, and cultivating maize (Hoopes 1995). All of these activities, simple as they are, have serious implications for habitat alteration. Pottery making, for example, is highly fuel intensive, especially at low technological levels. Open-air firings generally require the most fuel because they conserve and concentrate the least amount of heat. Costa Rican populations were relative latecomers to this technology. The earliest evidence for New World pottery comes from the central Amazon, with dates around 7000 BC (Roosevelt et al. 1991, Roosevelt 1995). It is present in northern Colombia by 4000 BC (Oyuela 1995), coastal Ecuador by 3500 BC (Damp and Vargas 1995), and central Panama by 3000 BC (Cooke 1995). Even if fire was not being used to induce succession, the production and use of pottery is good indirect evidence that fire was altering the landscape. Each household probably had a large number of pots, which would need to be replaced as they were broken. While the firing of a pot required a significant investment of fuel, even more was utilized during its employment as a cooking vessel. Even if population densities remained low, the regular production and use of large quantities of pottery in Costa Rica over the course of 3500 years undoubtedly contributed to understory composition and forest reduction. [Section to be included on fuel requirements of representative open-air firings.]

Human alteration of tropical forests included both concsious and unconscious behaviors. One of the most dramatic effects was the introduction of new species. These included early domesticates such as maize, manioc, beans, and squash, but probably extended to species in undomesticated or semi-domesticated varieties. Among the latter were a variety of tree crops such as palms, most notably pejibaye (*Bactris gasipaes*) and the American oil palm (*Elaies oleifera*), as well as papaya and cacao. Human alteration of tropical forests also included selective use of wild plants and animals for food. Some species were favored, which may have resulted in either increases or decreases in frequency. The former occurred when humans acted as seed dispersers, propagators, or undertook husbandry to nurture and encourage growth. The latter occured when use did not encourage regrowth or replacement. Deborah and David Clark have documented peculiar distributions of *Iriartea* palm in forests at La Selva, Costa Rica. It was absent in areas that would have been readily accessible to Precolumbian populations, but persisted in areas that would have been inaccessible, suggesting selective cutting for the extraction of palm heart. Management was not always wise, even by native populations.

Anthropologist Michael Alvard notes:

Native peoples have often been portrayed as natural conservationists, living in "harmony" with their environment. [He argues] that this perspective is a result of an imprecise

definition of conservation that emphasizes effects rather than actual behavior… Results indicate that hunters do not show any restraint from harvesting species identified as vulnerable to over-hunting and local extinction (Alvard 1993:355).

It is likely that ancient populations were responsible for reconfiguring local habitats, and that such reconfiguration over long periods of time resulted in patterned natural selection and microevolution.

Early Village Expansion, 500 BC - AD 500

The period between 500 BC and 500 AD is one of widespread agricultural expansion throughout Costa Rica. In the northwest, villages with black-on-red and red-on-buff pottery are found throughout Guanacaste, from the Pacific coast up into the Cordillera de Tilaran. There was a significant increase in the population of the Arenal Valley, with most of the identified village sites having evidence for occupation during this period. Michael Snarskis has identified this period as the one in which maize agriculture became the dominant form of subsistence. Villages with houses of both circular and rectangular foundations were found throughout the Atlantic lowlands and Central Valley. In the southern Pacific region of Costa Rica, there is evidence for the emergence of ranked societies and individual leadership, probably based on the cultivation and redistribution of agricultural products.

The expansion of both villages and agricultural fields probably resulted in significant alteration of tropical forests throughout Costa Rica at this time. Ceremonial jade axes became popular status items, and have been identified as emblematic of the tools of forest clearing and agricultural expansion. No village dating to this period has been explored in such a way as to reveal its spatial extent. However, treefall is a constant hazard in mature tropical rainforest. For this reason, villages would have required clearings even larger than the areas taken up by the houses and communal areas. House construction and maintenance placed additional demands on timber resources, but these are likely to have been small compared to fuel usage. Shallow soils erode quickly when denuded of vegetation and subjected to regular traffic. Secondary effects of deforestation and erosion would have included higher temperatures and velocities of water runoff, altering the ecology of nearby drainages.

One of the most significant effects of agriculture was the introduction of new species of plants, including maize, beans, cacao, and pejibaye. Swidden agriculture would also have resulted in environmental alterations. Just how prevalent slash-and-burn agriculture was remains untested. However, some of the most revealing evidence for its usage comes from test excavations at the La Selva Biological Station in northern Costa Rica. Here, research by Ifigenia Quintanilla and Robert Sanford indicated that areas that had been identified as "mature, intact" rain forest of the type described as "virgin" (Hartshorn 1983) were actually growing on top of charcoal-bearing strata. Archaeological excavations revealed habitation features, ceramic fragments, and other artifactual associations that strongly suggested agricultural burning in the period between 500 BC and AD 300 and again around AD 900 (Quintanilla 1990, Horn and Sanford 1992:356). It

is around this time that we find a rapid and widespread expansion of agricultural communities. The greatest expansion appears to have begun around AD 300 and lasted until AD 800. In central and eastern Guanacaste, this period represents a time of numerous, widespread agricultural villages, all of which were producing prodigious amounts of high-quality pottery. In the heavily surveyed Arenal and Cañas-Libera regions, settlement was almost continuous.

Hunting placed regular and patterned demands on animal populations. At present, there is little evidence for the specific food resources of the earliest villages in Costa Rica. From 2000 BC until around AD 500 there is little useful information about either the relative or absolute quantities of different species taken. However, after AD 500 archaeological sites in coastal Guanacaste and the Golfito area indicate the hunting of large mammals such as deer and tapir as well as smaller species such as agouti, currasow, and opossum. Olga Linares (1977) has noted how alteration of the landscape through agriculture would have changed hunting resources. She uses the term "garden hunting" to describe how fallow fields would have attracted deer and other forest margin species, and how groves of fruit trees would have encouraged the growth of populations of favored small mammals, such as agoutis. Models for small mammal ecology that ignore the coevolutionary potential of symbiotic relationships with Precolumbian agriculturalists are bound to be incomplete. At least one species, the squirrel monkey (*Saimiri saimiri*) may have become adapted to anthropogenic habitats in the vicinity of ancient villages.

Further Population Expansion, AD 500-1000

The period between AD 500 and 1000 was one of further population growth, with the emergence of a number of nucleated centers. Among these was Guayabo de Turrialba, the largest known settlement in the Reventazon Valley. The principal technological introduction of this period was the working of gold and gold/copper alloys (*tumbaga*). While cold hammering of gold would have had no significant impact on fuel use, casting was a fuel intensive process. In the Térraba Valley, which appears to have been the principal goldworking region according to the supposed proveniences of thousands of gold artifacts, wood consumption would have increased as metallurgy augmented the previous requirements of ceramic workshops.

Among the most impressive aspects of the Precolumbian landscape of Costa Rica at this time was the existence of extensive systems of roads and footpaths. In the Arenal region near Tilaran, footpaths over a thousand years old are still visible in aerial photographs due to the deep ruts they left in the earth (Sheets and Sever 1991). Excavations of cross-sections of these features have provided broken pottery, demonstrating their relationships with nearby villages. In central Costa Rica, remains of a stone pavement uncovered in March 1994 in a suburb of San José. Made of river cobbles and flat stones, the feature measured between five and seven meters in width and about 250 m in length. It has been dated to ca. AD 400 - 900

The Precolumbian Climax, AD 1000-1500

The five hundred years prior to European contact (Columbus touched the Costa Rican shore in 1504) were characterized by peak population densities in Guanacaste, the Central Valley, the Reventazon Valley, and the Térraba-Coto Brus Valley. Guayabo de Turrialba grew to its maximum size, declining sometime before Spanish colonization of the region (the existence of this large site was not reported until the mid-19th century). In Guanacaste, the standardization and wide distribution of similarly decorated ceramics suggests the existence of villages that specialized in the production of specific pottery types. These are likely to have placed high demands upon surrounding sources of fuelwood, possibly shifting in location as fuel sources became depleted.

As populations grew, more of the country was crossed by paths and built roadways. The best documented of these is at Guayabo, where a paved walkway measuring about 8 m wide enters the site from the southeast and extends for about 150 m. Another *calzada* leads away from the site in a north-northeasterly direction for a distance of around 7 km. There are suggestions that similar roads existed throughout the Central Valley and the Atlantic lowlands.. As has been true for modern roads through the rain forest, ancient footpaths in Costa Rica also opened additional areas to hunting, forest clearing, and agriculture. By traversing areas of forest, they improved access to species that would have been otherwise difficult to find. The development of extensive footpaths and roads undoubtedly had as significant an impact upon Precolumbian landscapes for ancient populations as modern roads have for contemporary populations. Unfortunately, relatively little serious work has been undertaken to date in documenting just how extensive these paths may have been throughout Costa Rica and Central America as a whole.

Population and Depopulation

At present, estimates of the Precolumbian population of Costa Rica for ancient time periods are unavailable. There have been attempts, however, at estimating the total population prior to the arrival of the Spanish in the 16th century. The most recent estimate is that of 400,000 people (Denevan 1992a:291).

The earliest populations were the most highly mobile, with the heaviest reliance upon "wild" resources. They may therefore have had effects over wide geographic territories. Later populations, although still taking advantage of "wild" resources, were more sedentary and more dense. They would have had high levels of local alteration, including reduction of populations of food animals, artificial diversity of cultivated plants, and changes in soil loss and redeposition.

Caution is required in making inferences about Costa Rican populations prior to European contact from observations made a generation or two after initial contact. It is likely that significant epidemics, analogous to the plagues that swept western Europe in the 14th century, may have preceded even the earliest inland expeditions to Costa Rica. Smallpox has been documented as early as 1511 in eastern Panama(?), and epidemics began to ravage the Maya of the Yucatan Peninsula by at least 1515 or 1516 (?). The Annals of the Cakchiquels describes a major epidemic that occurred in 1519, five years

before the first *entrada* by Pedro de Alvarado in 1524. It killed a Cakchiquel leader. There is debate over identification of the disease with smallpox, measles, and influenza suggested. However, there are not doubts as to its high mortality rate and significant level of social disruption. The epidemic spread among several groups in the Maya highlands in 1520 and 1521. McLeod refers to epidemics as the "shock troops of the conquest", and estimates that they killed a third of the population of the Guatemalan highlands both through its direct effects and the vulnerability of those who survived the disease to subsequent infections.

In addition to the possibility of epidemics from the north, there is evidence that Panama's native population was decimated by disease in the first decades of the sixteeenth century. (It was this dramatic decline in the Panamanian population that provided the impetus for the development of a slave trade in Nicaragua, which by 1535 was reported by one royal official to have resulted in the loss of one third of the native population.)

We know that Costa Rican peoples participated in trade contacts with both the Maya and the Panamanians for centuries prior to the arrival of the Spanish, so is not unreasonable to assume that European diseases had reached settlements in Costa Rica either from the south or the north prior to Gil González' expedition in 1522. If smallpox and measles had not reached the Pacific coast by this time, it seems likely that one or both may have been carried by this expedition. For those familiar with the geography of Pacific Costa Rica, the González expedition seems like a herculean effort. The countryside over which it passed includes several areas that even today remain sparsely settled and difficult to traverse. It is hard to believe that Gil González and his men did not cross a landscape that was vastly different from that encountered even by the *entradas* of the 1560s in terms of the size of the population and the relative ease of passage via well-utilized trails and inhabited areas.

Even if the Costa Rican populations had been able to escape the first waves of epidemics, it is hard to imagine that they avoided those of the 1530s through 1550s. Measles is reported as pandemic in Central America between 1532 and 1534. A letter to the Spanish king written in Nicaragua attributes the death of six thousand Indians in Nicaragua to *sarampión*, while a royal treasurer in León, Nicaragua wrote to the king in June 1533 that there was a shortage of natives to pan for gold due to "many sicknesses which have struck them, especially one recently of *sarampión*" When Diego González' expedition for the interior of Costa Rica departed from Nicaragua in 1543, they were leaving an area already ravaged by disease. Between 1545 and 1548, another major epidemic swept Mexico and Guatemala. The *Isagoge Histórica* reports that in 1545 and again in 1576 many of the most populous and famous towns were "totally destroyed" by sickness and pestilence. One *encomendero* reports that, during the 1545 outbreak, three out of four Indians perished from disease. Although documents from Guatemala suggest the epidemic was not as serious in Guatemala, it was undoubtedly present and disastrous. In 1558, just two two years prior to Cavallón's departure for Costa Rica, it was reported that the kingdom of Guatemala was "almost destroyed" by a disease for which there was no cure. Several authors suggest that it was an outbreak of measles, although it may have been a combination illness.

The conquest of the central highlands of Costa Rica was almost certainly accompanied by epidemic disease. In 1560, as Cavallón and Estraga Rávago were departing from Granada, Nicaragua, the *audiencia* in Guatemala reported to Philip II that "everyone is sick and ridden with pestilence" and that "a very great number of Indians have died". The epidemic in Nicaragua, exacerbated by a drought, continued until at least 1563.

The effects of disease introduce a significant level of complexity into the interpretation of indigenous societies and their environments in Costa Rica on the eve of the Spanish conquest. Our best ethnohistoric information on the native inhabitants of central Costa Rica comes from the reports of Cavallón, Coronado, and their contemporaries, all of which date to after 1560. By this time, virtually all of the generation living at the time of Columbus' arrival had died. Population estimates based on these documents are likely to be in error. It is therefore impossible to substantiate claims that the Precolumbian population of Costa Rica was small and insignificant. Forty years in an environment such as Costa Rica's is plenty of time for abandoned villages, agricultural fields, and trails to revert to secondary forest. The regeneration of the Central American landscape was undoubtedly rapid and thorough. During the exploration of the Caribbean coast of Panama in 1502-03, Ferdinand Columbus described a well-populated land with houses, planted fields, and few trees. By 1681, Lionel Wafer found the same area to be unpopulated and covered with forest (Denevan 1992b:378). In the event of a profound decline in population due to epidemic disease, the landscapes seen by Cavallón and Coronado in the 1560s may have only distantly resembled those of the Precolumbian period. The populations they encountered may even have been quite different from those encountered by Diego Guiérrez' fated expedition into the interior in the 1540s, which may explain why indigenous resistance against these later *entradas* was not as fierce.

Regeneration

Given the enormous amount of ecological education that occurs in Costa Rica, in part due to the successful program organized by participants the Organization for Tropical Studies, it seems important to me that individuals who approach contemporary forested environments in Central America be more aware of the presence of humans in these ecosystems for the past 12,000 years or more. As archaeological excavations at La Selva have revealed, it is very easy to mistake some 500 years of forest succession as the survival of a "forest primeval". Humans had a pervasive influence on Central American landscapes. Even small groups, if placed on a given landscape for thousands of years, probably effect lasting changes.

It is common, when discussing the modern deforestation of Costa Rica, to show a succession of maps from the 1950s to the present, indicating the rapidly shrinking areas of forested land. However, given the radically different nature of the Precolumbian landscape, one wonders just how much of the forests of the mid-20th century-or today--are more than 500 years old. To what extent did refugia play a role in the evolution of human-depleted tropical rain forests? What might the "domesticated" forests of the Precolumbian landscape have really been like?

Conclusion - Towards a Deeper Environmental History

As an archaeologist, it is striking to me how much of the environmental history of the Earth over the past two million years lies outside the consciousness of colleagues who are not familiar with what archaeology has taught us. Even if the only way that hunting and gathering populations could affect local habitats were through the use of fire, familiarity with its usage should be sufficient to demonstrate that human alteration fo the environment has been profound and regular for a substantial part of the past. Two million years is plenty of time for coevolution to occur in any living species, and it has probably taken place in many more than ecologists have been willing to consider. The problem, however, is only partly the fault of non-archaeologists. Archaeologists in general have been notoriously poor at recognizing the importance of their data for questions outside of a narrow field of interest in past human cultures. Just as ecology has tended to focus on the evolution of the natural world, archaeology has focused on the evolution of human culture. The separation between the two is artificial, and must be remedied through more direct interdisciplinary collaborations. Ecologists and environmental historians should learn more archaeology, but archaeologists should also learn how to address a much wider audience.

Human impact on the ecology of the New World did not begin with the arrival of European settlers. Nor is the story of twelve millennia of human occupation one of "low impact" with few lasting effects. In fact, it is likely that alteration of the landscape in the indigenous past was at least as significant as it has been in the European present. "Is it possible that the thousands of years of human activity before Columbus created more change in the visible landscape than has occured subsequently with European settlement and resource exploitation? The answer is yes for most regions for the next 250 years or so, and for some regions right up to the present time" (Denevan 1992b:381). Archaeology has the potential to reveal many of the details of these past changes, and of the place of human culture within nature.

The archaeological record makes it clear that, for at least the past 12,000 years, humans have been a "force of nature" in the New World. Imagining a landscape without them may be an inspiring myth, but it has no basis in reality. As archaeological resources disappear, in some places more rapidly than "wilderness" areas, the fact of human presence will become even more readily ignored. Just as the landscapes of the 18th century appeared to be more "pristine" than those of the 16th century, human alteration of environments in the 21st century will appear to be "newer" even than it does today. A great deal of current environmentalist rhetoric draws its strength from the notion that the American landscape, largely "virgin" at the time of its initial colonization by Europeans has been "damaged" by the industrial revolution. The increasingly popular myth that indigenous populations had minimal impact on their environment is bound to become more convincing as the traces of that population are gradually effaced. The reconstitution of habitats from refugia probably occurred widely during two phases of the environmental history of the New World, once at the beginning of the Holocene and again after the massive depopulation event of the 16th century. It is conceivable that such

a reconstitution could happen again. However, archaeological sites, unlike plant and animal species, cannot be regenerated. I hope that an increased appreciation of the significance of archaeological remains for accurate studies of ecology and environmental history will result in more effective conservation of these irreplaceable resources.

Unfortunately, critiques of the notion of "virgin" environments as myth run the risk of being taken the wrong way. Noting that Indians used fire to "clean up" landscapes does not justify the use of heavy equipment to clear-cut of old growth forests. The myth of the American wilderness is a powerful element in our own history and cultural identity. From it, we have developed an aesthetic appreciation for "wild" places. There is overwhelming evidence that biodiversity conservation is a wise strategy, if only to insure that the forces of natural selection can always act upon a high level of genetic variation. However, the myth that we are conserving forests so that we can "restore" past environments that had no humans in them will ultimately ring hollow. In the 20th century, any forest without humans is no different from Joni Mitchell's "tree museum"-as artificial as any garden. Isn't it more honest to admit that the Earth is in fact a garden, that it has been one for a long time, and rather than being "stewards of nature" learn how to be better gardeners? As noted by ecologist Deborah Clark, "It's time to overcome this lack of comprehension of humans as part of the ecosystem" (quoted in Yoon 1993).

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