



# The contributions of zooarchaeology to historical ecology in the neotropics

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## Abstract

Zooarchaeology can contribute to issues that lie beyond the traditional boundaries of archaeology and paleobiology. The techniques and methods of zooarchaeology are essential to an historical ecology that has emerged as a powerful perspective for understanding indigenous peoples and landscapes of the neotropics, both in the present and the past. In order to realize fully its potential contributions to historical ecology, zooarchaeology must reject the arbitrary dichotomization of culture and nature and a viewpoint that considers indigenous peoples as passive reactors to environments rather than as active creators of human landscapes. Zooarchaeology must avoid the seduction of neo-Malthusian assumptions that underlie many cherished models, and should do more than simply list extinctions at the hands of prehistoric humans. Instead, zooarchaeologists should focus on the study of past human landscapes, explore dynamic disturbances and the human maintenance of habitat mosaics, record the infrastructure of intensive agriculture, and understand the indigenous logic of past biodiversity management. When archaeologists study the landscapes of previous human populations, they are engaged in the practice of historical ecology.

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## 1. Introduction

The Indians created the environment we're trying to protect.

They should get to stay there while we're learning what they did.

William M. Denevan (in Mann, 2000, p. 789)

While writing a book review some years ago, it occurred to me that zooarchaeologists spend too much energy trying to convince others of their relevance to archaeology. We have all heard assorted pleas for expanding and integrating multidisciplinary research, which is understandable considering the bleak views that some archaeologists harbor toward faunal analysis (e.g., Shanks and McGuire, 1996, p. 82). I am certainly not immune to these perspectives; however, I am resolute in my opinion that we control proxy data directly applicable to highly significant issues of universal interest. They extend far beyond the traditional boundaries of archaeology and paleobiology and engage some formidable dilemmas facing humanity today.

Eminent paleontologist Niles Eldredge considers our current biodiversity crisis as a human-induced “sixth extinction” that mimics an end-Cretaceous bolide (Eldredge, 1999, p. 4). Although every organism modifies its surroundings, our species has declared its independence from nature. The combined effects of rampant human population growth and the constant demand for increased resource extraction have taxed an already stressed world with limited resources (McKee, 2005). Our globally pervasive human influence is responsible for extensive transformations of land surfaces, alterations of biogeochemical cycles, climatic modification, and the loss of biological diversity (Vitousek et al., 1997). Anthropogenic processes are the most important ecological forces operating on nature today (Soulé, 1995, p. 143). The current loss of species richness is either directly or indirectly attributed to human action through habitat destruction and fragmentation, overexploitation, translocation of exotics, pollution, and anthropogenic effects on climatic variability (Orians and Soulé, 2001).

It is ironic that today human involvement is necessary for maintaining “wild species” diversity and “wild ecosystems” function (Vitousek et al., 1997, p. 499). Whenever we

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aspire to reestablish an ecological state that functioned at some place and time in the past, our conservation efforts require environmental baselines for restoration, reintroduction, and removal because we must first approximate exactly what ecological conditions might have existed at that particular point in time. These decisions are necessarily arbitrary judgments (Orians and Soulé, 2001, pp. 6–7) because dynamic environments continuously transform and change. The deep historical perspective of archaeology provides a unique and important contribution for assessing these questions and for implementing rational and justifiable conservation efforts. In particular, through zooarchaeological methods, we directly control potential evidence that can be used to establish reliable inferences about past ecology—the preserved remnants of organisms that are either directly relevant to or indirectly implicated as proxies for understanding past conditions.

In this paper I discuss the potential contribution of zooarchaeology to historical ecology, restricting my comments principally to the South American neotropical lowlands. I begin by examining debates on human/environment relationships, specifically as they are framed with respect to indigenous land rights in the area. Next, I turn to the development of historical ecology as a powerful perspective for understanding the interrelationship of people and landscapes, both in the past and the present. An archaeological perspective is essential to historical ecology, and the specific techniques and methods of zooarchaeology enable us to play a valuable role. However, we must reject the arbitrary dichotomization of culture and nature and stop viewing indigenous peoples as passive reactors to their environments rather than as active creators and managers of landscapes. We must avoid the seduction of neo-Malthusian assumptions that underlie many of our cherished models. We must also go beyond the simple listing of extinctions at the hands of prehistoric humans. Zooarchaeologists should focus on the study of the past human landscapes, explore dynamic disturbances and the human maintenance of habitat mosaics, record the infrastructure of intensive agriculture, and understand the indigenous logic of past biodiversity management. Whenever archaeologists engage human sites and landscapes in the buried record, they are engaging historical ecology.

## 2. Perspectives on human–environmental relationships and conservation

Over the past few decades, an old debate with ancient roots has reemerged and intensified: do certain human populations, variably cast as primitive, traditional, or indigenous, embrace perspectives that can be considered as either more or less ecologically viable than others? This is a formidable matter, particularly in neotropical countries where indigenous land rights are often juxtaposed with biodiversity management (e.g., Clad, 1984; Redford, 1990; González, 1992; Alcorn, 1993; Alvard, 1993, 1995; Redford and Stearman, 1993, 2000; Peres, 1994; Stearman, 1994;

Vickers, 1994; Schwartzman et al., 2000; Terborgh, 2000; Chapin, 2004). At issue is whether indigenous peoples perceive their environments in an ecological perspective, act as conservationists, or share any pretense towards environmentalism. Others argue that it is better to consider their imprint as simply an epiphenomenal illusion that looks like something which it is not due to low population density and plentiful resources (e.g., Alvard, 1995; Soulé, 1995; Krech, 2005).

Certainly, in this form, the debate distorts reality. I agree with Nadasdy's (2005) recent assessment that it is spurious, as it imposes an inappropriate set of cultural assumptions on people who share ideas and expectations that are different from our own. We must also be aware of Nabhan's (1995, p. 91) cultural parallax of the wilderness concept, which misrepresents diversity by assuming that all indigenous peoples, past or present, shared a single "American Indian" or "native American" metaview of nature. We must also remember that this is not simply a disconnected philosophical dispute; it has significant consequences for real people whose rights are regularly based upon decisions made by others about their ecological perspective and expertise. We must consider that some 85% of the world's protected areas are inhabited by indigenous people (Colchester, 2000), and that 86% of South America's national parks are inhabited or used by local populations (Little, 1999, p. 269).

Is "traditional" management "benign" or "ecologically sensitive" and therefore compatible with the goals of conservation, or should biological preserves and biodiversity management exclude indigenous peoples (Nabhan, 1995, p. 87; also Chapin, 2004)? Current efforts in conservation biology focus on this debate out of a wish to maintain or restore natural ecological functions as completely as possible within protected areas. Is there a place for humans within protected areas, and, if so, specifically who is allowed in? Of course, a major problem includes defining what "natural" means, and where and when it occurred, especially during a climatically unstable Holocene when human populations inhabited much of the earth's surface. When forced to choose a temporal benchmark for their goals, conservationists generally favor a pre-European yardstick, although many would consider all human activity as unnatural, and ideally prefer to focus on the natural structure and function of ecosystems in the absence of humans (Hunter, 1996).

Today, some might still suggest that conservation efforts should focus on emulating ecological conditions before they were disturbed by human hands, under the misguided belief that natural ecosystems function in balanced, homeostatic, or equilibrium states. The origins of these ideas are ancient and can be traced to the Greeks and probably earlier (Botkin, 1990; Scoones, 1999). They certainly dominated the ecology of the mid-1900s, found their way into the neofunctionalist orientation of cultural and evolutionary ecology, and served as guiding paradigms in archaeology. Despite lingering in both scientific and

public circles, the domination of equilibrium, homeostasis, and stability began to shift gradually in the 1970s towards an emphasis on non-equilibrium disturbance, catastrophe, and variability as guiding features in ecological processes. In particular, history and temporal dynamics, which had a distinct incompatibility with the older homeostatic models, came to be featured in the new ecology, as did the collapse of the nature/culture dualism that served as a baseline for scientific thought (Botkin, 1990; Winterhalder, 1994; Biersack, 1999; Little, 1999; Scoones, 1999).

### 3. Historical ecology in the neotropical lowlands of South America

Although not entirely new, historical ecology has emerged along with other contemporary ecologies as a framework for reinvigorating a neofunctional ecological anthropology that failed to adopt a diachronic perspective. The language of the latter dichotomized culture and nature and emphasized that humans adapted to the fixed environmental circumstances in which they found themselves. In contrast, historical ecology focuses on the cultural and historical production of landscapes which shape cultural experience by retaining the material manifestations of human action (Crumley, 1994; Headland, 1997; Balée, 1998, 2006; Biersack, 1999; Balée and Erickson, 2006). Balée (1998) emphasizes four postulates central to the perspective of historical ecology. (1) Human activity has significantly affected most of the earth's surface which has been progressively transformed into managed cultural landscapes. Human actions over time are manifested in a landscape that retains physical evidence of cultural practices, decisions, and ideas (Crumley, 1994, p. 9). What we have long viewed as nature minimally contains the effects of human activity (Scoones, 1999, p. 490), and is often its outcome or product (Balée, 1989; Heckenberger et al., 2007, p. 199). (2) During the course of historical landscape transformation, there is neither a predetermined trajectory toward habitat degradation and extinction, nor to habitat amelioration and increased speciosity. Cultural actions are not always deleterious, as they can also lead to biological maintenance and or augmentation (Balée, 1989, p. 3, 1992a, p. 186, 2006, p. 86; Crumley, 1994, p. 12). (3) The trajectories of the landscape are historically contingent, and are therefore not subject to predestined outcomes. (4) Humans and the landscapes they created cannot be considered apart from each other.

Historical ecology provides an important and powerful perspective for understanding the past and the present situation of indigenous peoples and landscapes in the neotropical lowlands of South America. The small groups of shifting cultivators that currently live in marginal isolation throughout the extensive lowland areas of the continent are descendants of larger, more sedentary social formations that occupied different habitats at the time of European conquest. Ensuing disease pandemics, warfare,

slavery, missionization, and globalization dramatically changed the nature of indigenous societies, both quantitatively and qualitatively. Survivors were forced to choose amongst a limited number of available options which variably included dramatic alterations in the nature and location of their residence and the essential character of their subsistence pursuits.

Contemporary characterizations of indigenous societies are primarily the products of recent history and serve, for the most part, as inaccurate portraits of the pre-Columbian past. The neotropical lowlands were once inhabited by larger and denser human social organizations with greater permanency and complexity. The ancestors of today's survivors developed an elaborate landscape infrastructure which continues to sustain contemporary populations and underlies much of what is considered by many as "nature" (e.g., Carneiro, 1961; Lévi-Strauss, 1963; Denevan, 1966, 2001, 2006; Lathrap, 1968; Balée, 1988, 1989, 1992b, 1994). The implications of this historical ecological perspective have enormous consequences for key issues in biodiversity conservation and management, rational development, and indigenous rights. This is precisely where an archaeological perspective—and I would here stress zooarchaeology's techniques and methods—can play a potentially valuable role.

### 4. Zooarchaeology and historical ecology

Landscapes are the infrastructural legacies of past human action and contain cultural or social "capital" to be exploited by succeeding human populations (Erickson, 2003a, p. 182, 2003b, p. 456). The exploration of these ideas can only be achieved through archaeology, which has an unparalleled perspective for uncovering landscapes in time and space, and thus serves as a powerful, if not essential, tool for an historical ecology that is based on the primacy of history. We must also broaden our focus. Referring specifically to Amazonia, Erickson (2003b, p. 456) maintains that, by adhering to the "site concept", archaeologists have limited their understanding of historical ecology. A landscape perspective considers human activity as spatially continuous rather than constrained to localized sites, and therefore links archaeology to historical ecology. I believe that this is where zooarchaeologists have much to offer. Moreover, as an archaeologist, I feel strongly that this focus is particularly suitable for our characterizations of neotropical environments in the lowlands of pre-Columbian South America.

A standard assertion in zooarchaeology is that the techniques and methods we regularly use to interpret faunal assemblages can contribute to a broader understanding of human subsistence and paleoenvironments. Whether we like to admit it or not, most of us tacitly accept the environment as the variable to which human subsistence pursuits may or may not adapt. We certainly understand that environments are temporally and spatially labile; however, by treating environments as the products

of nature, it logically follows that we must accept the premise of a “pristine” environment that existed somewhere at some time untouched by human hands, especially before European civilization entered the picture. Although it is quite possible that some remote island or distant portion of a continent never experienced a human until recently, the idea of locating pristine or natural environments during the Holocene is a misnomer. Nevertheless, a pursuit of the pristine wilderness drives at least some of the policies of preservationists, in their belief that ecological integrity can be maintained in, or restored to, a damaged nature when left alone by humans. As already mentioned, few ecologists accept equilibrium today, but the basically urban perception of untouched wilderness permeates our collective conscience (Gomez-Pampa and Kaus, 1992). For practical reasons, conservation managers draw some arbitrary baseline for restoring or emulating wilderness ecosystems of choice. They usually choose AD 1500 as the clearest or the least ambiguous temporal benchmark (Houston and Schreiner, 1995; Hunter, 1996). Although some might grant greater credence to this position in the western hemisphere because it was populated late in global history, we should reject the idea of pristine wilderness, certainly since the onset of the Holocene (e.g., Denevan, 1992; Gomez-Pampa and Kaus, 1992; Nabhan, 1995, p. 93; Stahl, 1996; Balée, 1998; McCann, 1999; Foster, 2000; Crumley, 2001; Kirch, 2005; Heckenberger et al., 2007). If, as I regularly read in the literature, many zooarchaeologists accept, or at least feel comfortable with this position, then why do we still proceed with the tacit assumption that the environment is somehow a given against which humans react?

#### 4.1. *Analogs without history*

Some have suggested that South American archaeologists are relatively “privileged”, at least because they work on a continent that still retains “traditional” or “intact” indigenous. This would be particularly prevalent in the neotropical lowlands where ethnographic and historical analogs are regularly mined for constructing inferences about a distant past. For various reasons, anthropologists and biologists have studied indigenous hunting practices, measured return rates, and assessed the impact of subsistence economies in neotropical environments. Some wish to gauge the effect of indigenous practices in biodiversity preserves. Others are interested in how “primitive” peoples exploited past environments. Archaeologists regularly use studies of “small-scale societies” as contemporary analogs for understanding “traditional” pre-Columbian practices, usually under the assumption that we can apply lessons learned from these people to any world area of our choice because they represent contemporary examples of past or “primitive” conditions. “Small-scale societies” are assumed, rather than demonstrated, to be contemporary examples of how prehistoric peoples adapted to their environments, in which the latter are

treated as independent variables against which culture reacts. This is particularly important in the neotropical lowlands where lingering scientific and popular perceptions still consider these areas as contemporary examples of pristine environments that have survived “intact” into the present along with their “traditional” human inhabitants.

In most cases, “traditional small-scale societies” occupy marginalized environments because of historical circumstances. Some may have persisted in these areas, some may have fled to these areas, but in any case they survived in these areas precisely because they are of marginal significance to national and international interests. In no case can they be considered as intact survivals from the Paleolithic or any earlier time in prehistory. Not only do they possess a history, like anyone else, but they may be inappropriate analogs for constructing inferences about peoples of the past. Sauer (1947, p. 19) warned us of this years ago, when he referred to contemporary hunting peoples as “modern survivors, now restricted to the most meager regions of the earth”, that are quite unlike their alleged prehistoric counterparts who presumably lived under more opulent circumstances. This is likely true for many marginalized neotropical foragers who maintain their lifestyle today for historical reasons (Lévi-Strauss, 1963; Lathrap, 1968). Theirs is not an indication of original conditions, but of colonial duress (Sahlins, 1972).

Balée (1988, 1992b, 1994, 1995) has coined the term “agricultural regression” to describe the historical process by which the sedentary agriculturalists were forced to adopt alternate subsistence practices. Neotropical agriculturalists responded to colonial pressures in a number of ways, including migration into uninhabited forest located far away from preferred subsistence areas. As once sedentary populations fled areas of European influence, their need for increased mobility prompted a gradual loss of crops from the agricultural inventory and an increased reliance on uncultivated plants over time. Populations that were at one time sedentary farmers eventually adopted semi-nomadic and transient lifestyles. We must consider that the environments exploited by these semi-permanent and transient foragers include fallow landscapes left behind by the previous agricultural populations. Through the process of agricultural regression, farmers became foragers no longer dependent upon horticulture but dependent upon those that once practiced it (Balée, 1994, p. 219). Although Balée’s thesis focuses on post-conquest changes, we must also consider the likelihood of pre-conquest trajectories as well, a point recently emphasized by Rival (2006), and long championed by Lathrap (1968).

That is not to say that all neotropical foragers are necessarily regressed agriculturalists. It is certainly possible that foraging represents a longer-term human subsistence strategy in a forested context that has been characterized as difficult to exploit in the absence of plant or animal domesticates (e.g., Headland and Bailey, 1991). Nonetheless, it would be impetuous to characterize such people as ancient, intact, or pristine. Certainly, compared to

indigenous farmers, relatively little is known about hunter–gatherers in South American anthropology, but the work of Politis (1996) clearly demonstrates that small bands of contemporary foragers can act as sophisticated and dynamic managers of forest landscapes. Not only do the Nukak Makú of Amazonian Colombia relocate their highly mobile residence patterns before local resources are overexploited, but they manage and manipulate important dietary plant species (see also Gnecco and Mora, 1997). Through subtle discriminatory forest thinning and frequent residential camp movement, the Nukak create concentrated resource patches or “wild orchards” which they exploit and expand through continued visits. As the Nukak “move to produce” mobility serves as a means to manipulate and concentrate valuable resources in a sophisticated landscape management practice that questions the very basis of pristine nature in the neotropical forests (Politis, 1996, p. 508). Likewise, the cumulative historical impact of harvesting/dispersing fruit trees, manipulating palms, exploiting gaps, and extracting honey by the Hoti in southern Venezuela is likely greater than the effects of slash and burn agriculture (Zent and Zent, 2004, pp. 85–98).

#### 4.2. *Seduction of neo-Malthusian assumptions*

Zooarchaeologists often rely heavily on neo-Malthusian assumptions, particularly as prime movers behind the modeling of resource depression, diet breadth, and agricultural origins. Malthus’ (1798) proposal, that unchecked population growth increases in a geometrical ratio while subsistence resources increase only in an arithmetical ratio, was a philosophical reaction to existing utopian beliefs about the perfectibility of humankind and attempts at reshaping the poor laws of Georgian England (Boorstin, 1986, p. 474). Concerning the former, Malthus warned of the tendency for actual population growth to outstrip food supply, such that any attempt to improve the condition of the poor was pointless as this would invariably lead to increased population and subsequent misery and vice. It is important to remember that Malthus’ propositions were developed in the context of philosophical and political debates current at the time, as is clear in the full title of his essay. In short, they remain as assumptions.

There are also political and economic motives involved. Guyer and Richards (1996) raise provocative concerns about the politics of biodiversity, which they see as bound up in neo-Malthusian perspectives on demography. These are often linked with conservative and neo-liberal attitudes toward the third world, where the conservation dilemma is particularly intense. They point out that “pristine” areas are naturally rich in biodiversity, and unknown biodiversity is a potentially valuable resource. It is this potential value that serves as a pretext for excluding humans (usually poor subsistence level farmers and foragers) from protected areas, and strengthens the capacity of elites to enforce their exclusion.

Although it is hard to dispute the current global human population boom, the Malthusian assumption of inexorable human population increase remains an assumption. Some might characterize population increase as an unavoidable aspect of evolutionary destiny, in the belief that human resource use has evolved to maximize inclusive genetic fitness, or the success to which genes are passed on to future generations (Kohler, 2004, p. 264). I remain skeptical of this “pan biological evolutionary logic”, as I do not believe that human populations, or any populations for that matter, can increase their numbers unless the supporting conditions are appropriate for them to do so. This brings us back to historical ecology. Any conditions that are appropriate for supporting human population increase are to be found as physical signatures within the landscape, which represent the historically accumulated capital of previous human generations. It is the human landscape which can create the conditions that can promote human population growth. It is precisely this historical capital that we should be studying

#### 4.3. *More than just recording extinctions*

Based on a sampling of the literature, some might suggest that historical ecology is the study of anthropogenic extinction. Holocene extinction can be a critical component of historical ecology, but there is certainly much more. Some argue that anthropogenic extinctions of Late Quaternary faunas in the Americas were strictly terrestrial accidents between first contact human predators and their prey. Economic optimizing models predict that large, delectable, and accessible prey would be the earliest to disappear in all first contact extinctions (Martin and Steadman, 1999). However, colonizing humans also introduce exotics, including Crosby’s (1986) “portman-teau” and unintended faunas, and new diseases. They alter habitat structure and place unusual stress on keystone species, whose removal prompts cascading effects throughout the ecosystem (Martin and Steadman, 1999). An important corollary of the “human bolide” is that global extinctions over the past 40 millennia have so changed the earth’s surface “that historic observations and assumptions about what is natural are misguided” (Martin and Steadman, 1999, p. 26).

Although first contact populations could be considered as examples in which humans encountered specific landscapes for the first time, Late Pleistocene humans migrated into a New World at a time of profound global change when environments were anything but fixed. Dominant extinction scenarios suggest that we understand first contact humans as destructive optimal foragers pillaging in a new and pristine environment. Zooarchaeologists, in particular, are fascinated by the logic of optimal foraging models, which is often understood as a universal given. However, I agree with Hardesty and Fowler (2001, p. 76) that we should question whether humans are process driven by the basic assumptions of evolutionary ecology, or

whether we should understand human action as a matter of cultural preference and logic.

The Nukak Makú refuse to eat otherwise large and delectable deer and tapir (Politis, 2001). Their subsistence choices would seem to have little to do with optimal foraging logic and contradict its central tenets. In our dealings with the indigenous peoples of the neotropics, it was long assumed that the vast interfluvial habitats were starved of resources, especially protein. When the indigenes did not optimize in these severely limiting settings, we strove to explain this behavioral paradox in functional terms and sought some adaptive logic behind the seemingly contradictory behavior. Nuanced comparative studies have clearly demonstrated that these areas are neither resource starved, nor do their inhabitants have any interest in exhaustive exploitation (e.g., Descola, 1994, pp. 308–320). Food taboos are cultural, not ecological phenomena; certain foods are avoided not out of adaptive necessity, but by choice. Moreover, although heuristically productive, optimal foraging models must assume that the environments in which humans operate are independent variables; they are useless for taking into account a human nature that actively manipulates and creates the very environments which it exploits.

It appears probable that first contact humans reduced the richness and the abundance of bird life on isolated island ecosystems (Steadman, 1997). Recent studies on some islands link the introduced Polynesian rat (*Rattus exulans*) to vegetation change and avifaunal extinctions that may have taken place after initial human colonization yet prior to appreciable human population growth (Athens et al., 2002; Hunt, 2007). However, the evidence for continents such as the Americas is far less convincing. We know that the ecosystems on small, isolated islands react differently to colonizations and extinctions than do those on continents. We must also take into consideration that the apparent shortage of continental extinctions may simply be due to time lag (Brooks and Balmford, 1996). However, some would doubt that assumed synchronous Late Quaternary extinctions on continents had much to do with optimal pillaging by first contact humans. MacPhee and Fleming's (1999) meticulous study suggests that, over the past half millennium, few mammals were driven to extinction on continents other than Australia, and that modern mammalian extinctions cannot be considered as cases of anthropogenic overkill. Moreover, optimal foraging models can even be persuasively used to discard the model that first contact humans were optimizing mega-faunal specialists (Byers and Ugan, 2005). I must agree with Grayson (2001, p. 42) who has long argued that "overkill credos", particularly during the Late Quaternary period of the western hemisphere, are statements of faith.

Do humans adversely affect biological richness everywhere and at all times? Balée (1998, p. 23, 2006, p. 82) suggests that the only solid evidence for non-island extinctions is to be found amongst state societies. I suspect that despite our proclivity for large-scale habitat alteration,

especially after the onset of intensive agriculture, we could find many instances when humans decreased, and increased, species richness. The archaeological record is vague in that way. Our recovered assemblages are selected samples of selected animals whose selected remains were selectively accumulated, selectively deposited, selectively buried, and selectively preserved in selected locations. It is far easier to recognize extirpation than it is to record shifts in taxon abundance, such as identifying when and where human activity promoted an increase in certain animals through landscape construction and management. Some archaeological and historical studies have documented a local increase of plants and animals as either direct or indirect outcomes of human manipulation through increased niche diversification (e.g., Emslie, 1981a, b; Nabhan et al., 1982; Rea, 1983, p. 108; Mellink, 1985; Bye and Linares, 2000; Bernardos et al., 2004; Hayashida, 2005, p. 48). We must record what disappeared where, when, and possibly how and why; however, simply documenting human-induced extirpation is not enough (e.g., Kirch, 1997, p. 18). As an archaeologist, I want to know what humans were doing and how they were doing it. My personal career path has led me to explore these issues in the neotropical lowlands of South America before the arrival of Columbus.

##### 5. Historical ecology, indigenous landscape management, and zooarchaeology in the neotropical lowlands of South America

Although it is tempting to mine neotropical ethnography and history in South America for contemporary analogs that can be used to interpret a pre-Columbian past, these areas are precisely where the past is least known. We are easily lulled into believing that the neotropical lowlands survived basically unchanged since primordial times because we can actually see what we assume to be traditional humans and their intact environments surviving into the present. An historical ecological perspective would tell us that today's small-scale shifting cultivators, scattered widely throughout the backwater forests of *terra firme*, are not primordial reflections of indigenous life prior to the arrival of Europeans. Nor are the landscapes they inhabit pristine environments that represent some kind of fixed natural condition. Moreover, conservation efforts that are informed by the image of an "ur-forest" advocate "Edens under glass" from which local populations must be excluded (Hecht and Cockburn, 1989, p. 27; also Chapin, 2004; Heckenberger et al., 2007, p. 199). This guiding belief is not only misleading, but expressly harms those humans with the strongest claims for restitution. Archaeology is directly relevant to these issues because we study what past conditions were like and what humans were doing differently than they are today. The stakes are high, and, sadly, archaeology is one of the few available avenues for obtaining even a glimpse of this past.

The most obvious way for archaeologists to engage in this enterprise is to study landscapes. The new ecology eschews equilibrium and embraces dynamic disturbance as a regular and necessary element of ecosystems. Moreover, recursive disturbance promotes non-linear contingency (Botkin, 1990; Winterhalder, 1994; Zimmerer, 1994; Sponsel, 1995; Scoones, 1999). Ecologists recognize that gap phases, produced through repeated but unpredictable disturbances, are characterized by mosaics of different successional development which can prevent resource monopolization, promote population stability, and increase genetic structure (Wiens, 1976). Tropical rain forest ecosystems can only support high species richness when the frequency and the intensity of the disturbance is intermediate (Connell, 1978). This theoretical position is also explicit in indigenous management models. In Central Brazil, the Kayapó do not fell large trees with honey combs simply to gather honey, but expressly for creating *bà-krê-ti* (“large forest opening”), which attract game animals and provide spaces into which useful plants are introduced (Posey, 1998). In the tropical highlands of southern Venezuela, the Hoti actively create gaps through management of fruit trees and palms in addition to cultivating natural tree falls. Smaller scale, medium frequency, and low-intensity disturbances that are localized and reversible lend to biodiversity enhancement (Zent and Zent, 2004, p. 102). Hecht and Cockburn (1989, p. 28) remind us that the floodplains, which sustained the densest human populations, are unsurprisingly the Amazonian landscapes with the most productive natural disturbances.

The Kayapó, like many indigenous peoples, are agroforesters who integrate agriculture with forest management (Posey, 1998, p. 110), a widespread prehistoric practice (Denevan, 2001, p. 70, 2006). High temporal and spatial diversity through polyculture and agroforestry are salient features of traditional farming which contributes up to 20% of the world’s food supply (Altieri and Merrick, 1987, p. 88). Traditional agroecosystems like agroforestry, and swiddening, currently maintain relatively high-diversity forests in the face of encroaching monocropping and intensive logging (Noble and Dirzo, 1997), and promote the fast regrowth of diverse forest (Ferguson et al., 2003). Humans promote greater niche diversity by creating secondary forests, removing, protecting, or introducing certain plants, and producing mosaic landscapes and edges (Posey, 1998; Bye and Linares, 2000). Increased biodiversity is an intentional consequence of active indigenous management which produces secondary fallow forests of high species richness dominated by ecologically and culturally important taxa (Balée, 1994). Agroforestry (Griffith, 2000), secondary forests (Dunn, 2004), rustic coffee plantations (Perfecto et al., 1996), and coffee forest remnants (Daily et al., 2003) serve as contemporary refuges for animal and plant biodiversity in recently degraded environments.

Throughout the neotropics, habitat mosaics that are created and maintained as gardens and fallowed fields are

prime locations for procuring animal prey. Studies undertaken in contemporary lowland habitats suggest that non-hunted locales are dominated by large-bodied vertebrate frugivores–herbivores, whereas small and medium-sized frugivores and insectivores prevail in hunted areas. Contemporary hunting appears to have a more immediate impact on the larger mammalian prey taxa that are currently harvested in the forest fragments which tend to be too small for sustainable yield (Peres, 2000, 2001). As mean biomass and richness of mammalian prey declines, smaller, adaptable prey taxa like opossum (*Didelphis*), armadillo (*Dasybus*), agouti (*Dasyprocta*), paca (*Cuniculus*), tamarin (Callitricidae), coatimundi (*Nasua nasua*), ocelot (*Felis pardalis*), collared peccary (*Tayassu tajacu*), and red brocket deer (*Mazama*) predominate (Naughton-Treves et al., 2003; also Carrillo et al., 2000; Lopes and Ferrari, 2000). Agoutis, red brocket deer, and collared peccary are sustainably harvestable in some forest fragments due to their higher reproductive rates and population densities (Peres, 2000, 2001). Sloths (*Bradypus* and *Choloepus*) and howlers (*Alouatta*) can persist in forest fragments and secondary growth through folivory despite intensive hunting pressure (Schwarzkopf and Rylands, 1989; Lopes and Ferrari, 2000, p. 1664). Many smaller, opportunistic, and highly adaptable mammalian species are abundant as they invade clearings, remain relatively insensitive to or thrive in disturbance, and range outside forests because they do not depend upon them for survival (Cuarón, 2000, p. 1691; Daily et al., 2003, p. 1822).

Hunting and forest fragmentation are correlated as gardens promote sustained hunting, a point advocated many years ago by Linares (1976). Adaptable and cosmopolitan species that can exploit secondary vegetation and crop lands are “weedy” anthropogenic faunas (Naughton-Treves et al., 2003). For example, contemporary Mayan hunters experience higher harvesting rates and exploit diverse prey species like turkey (*Meleagris*), curassow (*Crax*), armadillo, agouti, paca, coatimundi, brocket deer, peccary, and white-tailed deer (*Odocoileus*) in habitat mosaics dominated by late stage fallow and closed canopy (Escamilla et al., 2000). When I identify generalist or eurytopic vertebrate species in the archaeofaunal record, I do not automatically think of resource depression or increased diet breadth; rather, I see archaeological correlates of forest mosaics and gardens (Stahl, 2000, 2006).

The landscapes of pre-Columbian agricultural intensification in the neotropical lowlands of South America are accessible in the archaeological record. The most conspicuous examples include indigenous raised fields distributed widely around the continent (Denevan, 2001, p. 222). Constructed and maintained for water management, plant growth, and intensive aquaculture, the raised-field systems (Fig. 1) represented significant landscape capital that enhanced the availability and habitat of local plants and animals for human use (Erickson, 2000, 2006). The creation of permanent, year-round wetlands, especially in



Fig. 1. Relic raised field in the Guayas Basin, Ecuador.

areas with markedly seasonal rainfall, has dynamic consequences for local biodiversity. Culturally important plant and animal resources are concentrated and increased within the context of highly productive wetland landscapes and the creation of terrestrial and aquatic interfaces (Erickson, 2006). Archaeofaunal assemblages associated with vast Late pre-Hispanic raised fields in the southern Guayas Basin of Ecuador testify to a rich resource base, including marine, freshwater and terrestrial invertebrates, sharks, catfish, drum, porgies, croakers, frogs, toads, mud and snapping turtle, iguana, snake, duck, ibis or spoonbill, hawk, guan or curassow, opossum, monkey, cotton rat, agouti, paca, dog, raccoon, otter, ocelot, deer, peccary, and rabbit (Stahl et al., 2006).

The Ecuadorian raised-field assemblages also include each of the native South American animal domesticates: muscovy duck (*Cairina moschata*), cuy or guinea pig (*Cavia porcellus*), and presumably domesticated camelid (*Lama* spp.). The archaeological record also suggests that these obvious cultural signatures of biodiversity manipulation were diffused into widespread areas of the pre-Hispanic world via cultural mechanisms (Stahl, 2003). Pre-Hispanic biodiversity manipulation, which might easily be mistaken as natural biogeographic distribution, involves the cultural translocation and introduction of non-domesticated exotics. Populations of wild cuy (*Cavia aperea*), the possible ancestor of domesticated *C. porcellus*, are characterized by disjunct geographic distributions in northern South America (Eisenberg, 1989, p. 392). These isolated colonies likely represent feral populations of the original domesticates distributed by humans. Similarly, the confusing taxonomy of the squirrel monkey (*Saimiri*) includes two comparable, yet allopatric species. Though behaviorally and ecologically similar, *S. oerstedii* is geographically confined to western Panama and Costa Rica, whereas populations of *S. sciurus* occur widely throughout Amazonian South America (Costello et al., 1993, p. 178). In his revision of the genus, Hershkovitz (1984) had suspected that the Central American populations may have been human introductions from South America. The possibility that human translo-

cation was possible is suggested by a squirrel monkey specimen identified in the archaeological record of the high-elevation tree-line La Chimba site in northern Ecuador (Stahl and Athens, 2001). This is further corroborated through high-resolution identifications of bird specimens which reveal a number of lowland species, including macaw, parrots, kites, and oropendola that might implicate a prehistoric bird trade, which was reported historically by early Spanish explorers (Tellkamp, 2005, p. 303). Disjunct distributions of highly similar neotropical jays can be explained by the pre-Columbian introduction of painted jays (*Cyanocorax dickeyi*) into western Mexico from a parent population of white-tailed jays (*C. mystacalis*) some 4000 km to the south in western lowland Ecuador and Peru. Long-distance movement of macaws (*Ara*) and grackles (*Quiscalus*), and an assortment of vertebrates, could be the mechanism for other unusual bird distributions that are often identified by biologists as relicts or storm-blown waifs (Haemig, 1978, 1979).

Amazonian dark earth (ADE) is a significant form of pre-Columbian agricultural intensification documented in the archaeological record of the lowland neotropics (Denevan, 2001, p. 104; Erickson, 2003b; Neves et al., 2003). Within an environment generally characterized by relatively impoverished soils, these dark earths are distinguished by their dark color, high fertility, and elevated charcoal content. We cannot underestimate the importance of ADE for grasping the extent of indigenous population size, permanence, and complexity in an area historically disparaged as excessively limited in potential. Data suggest their appearance in association with farming societies that lived in large, permanent villages and towns at least since the first millennium before Christ. In particular, terra pretas or black Indian earths are considered to be anthropogenic, and directly related to intentional human enhancement. The high concentrations of potassium, phosphorus, calcium, and nitrogen associated with ADE are derived in part from the inclusion of discarded fish, turtle, and other game animal bones (Glaser et al., 2004, p. 152). Minimally, in this latter sense, they provide possibilities for the contribution of zooarchaeology to further our understanding of neotropical prehistory, anthropogenic landscape formation, and resource management. Mapping their extent and distribution and studying how they were produced have far-reaching consequences for the past, the present, and the future.

## 6. Closing statement

When we consider humans as conservationists and resource managers or epiphenomenal optimal foragers, we avoid the real position that indigenous populations created the very ecosystems that we wish to conserve. Although the impact of previous human populations has been better appreciated in Europe for decades (Delcourt, 1987, p. 39), it is still popularly assumed that native America wielded a relatively benign and harmonious

presence. The balanced ecosystem of the pre-human landscape is likely no more than a cherished wish, certainly if one's conservation target is some place and time during the Holocene epoch. Little (1999) cogently explains that the appropriation of Amazonian forests as wilderness was consolidated in the century when indigenous people disappeared from social history, and that the protected areas which are regularly inhabited or used by local peoples were established at a time when certain scientific theories of conservation prevailed. Conservationists understand that nature is variable, and that choices must be made that are consistent with ethical reasoning (Soulé, 1995, p. 155). This is precisely why the quote by William Denevan, which opens this essay, makes perfect sense to me.

My position is not a part of an environmental backlash (Freyfogle, 2004). Nor is it a reversion to believing that, if humans tend the garden, they can improve nature. Nor do I believe that an intact nature is necessarily despoiled by humans (Botkin, 1990). In contrast, I recognize the real dangers involved in naively accepting simplistic viewpoints. If we embrace anything or everything as a legitimate product of history, or acquiesce to destructive practices because “nature is not natural anyway”, we succumb to the potential damage that can result from logically extended relativism (Soulé, 1995; see also Hayashida, 2005, p. 57). I am terrified by the implications of a human population boom that is out of control and seemingly oblivious to restrained resource consumption. I also do not wish to contribute to Nabhan's (1995, p. 90) cultural parallax by lumping all indigenous people under the same epistemological rubric.

My position originates from another perspective. I am an archaeologist, and attempting to find out what people were doing in the past, and perhaps why, is what archaeologists do. Zooarchaeology plays an important role in understanding where, when, and how pre-Columbian populations created, shaped, and managed the landscapes of the New World. I want to have at least some idea of what they were doing, rather than to project *a priori* opinions from the present onto their past for whatever philosophical reason. The long-term perspective of archaeology is the only tool available for us to accomplish this. Archaeologists, by definition, excavate and explore anthropogenic landscapes through time and space; therefore, we are historical ecologists.

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