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Land Management Among Hunter-Gatherers: Questioning the Ubiquity Claims

Abstract

Evidence that our industrial society, built on agricultural subsistence, is inherently ecologically destructive underlines the value in identifying which, if any, past human subsistence approaches have been ecologically benign. The traditional land management practiced by some hunter-gatherers is touted by some as a model of ecologically benign subsistence. In this paper I examine critically several broad assertions made commonly by proponents of this set of subsistence practices. These claims portray these practices as almost ubiquitous among human societies, in their impacts across land areas, and through time. Despite having been subjected to little scrutiny, these claims have contributed to the reputation, on the part of traditional land management, for ecological benignity. By analyzing them critically we can improve our understanding of traditional land management, laying a foundation for more effective examination of direct ecological impacts and long term consequences of this subsistence approach.

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Introduction

A range of analysts agree our current global society is, by its nature, ecologically destructive (Crutzen, 2002; Mitchell, 2010; Rees, 2000). Looking to the past raises questions concerning which, if any, human societies might have been ecologically benign. If we hope to respond thoughtfully to our ecological crisis, there is value in grappling with those questions, working to understand the relevance of the deep past to the human future, even if it means scrutinizing rarely questioned beliefs. As Milton (1996) writes:

> If, as many environmentalists argue, the industrial economy … is fundamentally and inevitably destructive towards the environment, then the future will rest with alternative ways of living…. alternatives that are genuinely benign towards the environment and not just held dogmatically to be so. (p. 31)

Assessing the alternatives, researchers often rule out agricultural societies. They point to evidence that agriculture triggered environmental impacts on a global scale (e.g., Ruddiman, 2003). Its advent meant a large increase in human manipulation of plants and soils, with an intensification of domesticating processes. As a subsistence method fundamentally different from the hunting and gathering which had characterized most of human existence, it also enabled by far the largest portion of the tremendous growth we've seen in human numbers (Bocquet-Appel, 2011), laying the foundation for highly visible, progressive damage to ecosystems for the sake of human consumption.

Nonagricultural societies

Once we rule out agriculture, we are left mainly with horticultural, pastoral, and hunter-gatherer (HG) societies. Though falling short of frank agriculture, some of these lifeways nevertheless centered much of their subsistence around the purposeful manipulation of plant life for food production, a fact obvious for horticulturists but true as well of some HGs who employed various "land management" practices. Common broad claims about the the latter have helped create for them a reputation as ecologically benign subsistence tools. Having only rarely been critically examined, these claims are the focus here. They paint a picture of such land management as pervasive among human societies, in its impacts across land areas, and through time, yet benign and even beneficial in its impacts. Contrasting with this view is one seeing this sort of land management as less pervasive but also less ecologically benign. I will begin here to develop the latter view, outlining its ecological component in subsequent work (e.g., Feeney, 2016).

Traditional land management

Some HG societies practiced a level of plant manipulation, actively, purposefully, and with horticultural intent, manipulating and influencing selected plant life via approaches less intensive than those used by horticultural or agricultural societies (Anderson, 2005, e.g., pp. 3, 4, 300; Deur & Turner, 2005; Fowler & Turner, 1999). Investigators have referred to this level of plant manipulation by such terms as "proto-agriculture," "low-level food production," "traditional resource management," and "indigenous land management" (Anderson, 2005; Deur & Turner, 2005; Fowler & Turner, 1999; Smith, 2001). Here I will use a hybrid of the latter two terms: "traditional land management" (TLM).

Anderson (2005), Deur and Turner (2005), and other researchers have done much to correct previous inattention to TLM in human lifeways, bringing to light a remarkable level of detail. There is, however, no clear, consensus definition of TLM. That said, bearing in mind that some of the terms used to describe it vary slightly themselves in definition (Smith, 2001), we can bring the idea into focus by noting how researchers describe it. Anderson (2005, pp. 1, 154, 332) describes its techniques as "horticultural" in nature. Writing on practices in the Pacific Northwest, Deur and Turner (2005b) speak of "plant enhancement" (pp. 5, 7), and place TLM within the realm of "cultivation," arguing cultivation can include much that is different from European agriculture while still involving "the manipulation of both plants *and* their environments as a means of achieving quantitatively and qualitatively enhanced plant production" (p. 5). A special case of TLM involves practices with no horticultural intent, but aimed at altering the landscape for the purpose of increasing animal food, that is to increase hunting efficiency. This describes, for example, the burning practices of some Australian Aboriginal peoples (Bird, Bliege

Bird, & Codding, 2016). Additionally, researchers describe TLM practices as “active” in nature (Anderson, 2005; Boyd 1999; Turner and Peacock, 2005). In essence, then, TLM involves active interventions with horticultural intent, or other intent to alter the landscape, for purposes of increased food production. TLM methods fall, on a scale of intensification, below those associated with fully horticultural and agricultural societies, methods higher on the scale having evolved, researchers believe, to produce more food (Ames, 2005).

TLM can include such practices as burning, coppicing, pruning, weeding, transplanting, replanting of propagules, sowing and planting seeds, irrigating, tilling, clearing, and fertilizing, all intended to influence plant growth patterns (Anderson, 2005; Deur & Turner, 2005). These represent an intensification of food production compared to pure hunting and gathering. They all increase human food and other plants of value to humans.

A closer look at what is and isn’t TLM

Overly broad descriptions of TLM fail to distinguish between TLM and related but conceptually different practices. As mentioned, TLM is purposeful and, apart from instances involving altering the land to increase hunting efficiency, involves cultivation with horticultural (“plant enhancement”) intent. Inadvertently dropping seeds while eating a piece of fruit is not TLM. Also clear in descriptions and lists of practices is that TLM contains an active element. Although practices such as sparing plants or their parts during harvesting are sometimes included in lists of TLM techniques (Fowler & Turner, 1999), their passivity separates them conceptually and fundamentally from the rest of the items in such lists, and their inclusion contradicts the repeated descriptions of TLM as *active* practices. Logically then, passive conservation practices should be classified separately from TLM. Refraining from taking all of a plant to avoid killing it, for example, is not TLM. It does involve a conservation purpose, and its planned quality may make it uniquely human. But TLM is not passive conservation; it is active cultivation (or alteration of the landscape). If members of an HG group learn they must limit their take of a certain plant in order to be able to return to an area again in the near future, this is thoughtful foraging with a conservation element, but not TLM.

Some practices can look superficially similar to TLM, but if they lack the elements outlined above they are best classified differently. As an example, after digging up a tuber for food, some HG groups leave a portion in the soil where it might regrow. For some groups, such as the Batek of Malaysia, this appears to be a passive conservation practice, simply refraining from taking too much. Judging from a description by Endicott and Bellwood (1991), it lacks the active cultivation or “plant enhancement” intent of TLM. For others, such as the Baka in Cameroon, a similar practice appears, on the basis of limited descriptions, to be less a passive “leaving” than an active replanting with horticultural intent. This has been termed “paracultivation” and probably shades into TLM (Dounias, 2001). Similarly, using fire to drive game may look similar to burning to promote the growth of certain plants. But the former is a hunting tactic with no horticultural or landscape-altering intent. The latter, on the other hand, qualifies as TLM as it involves horticultural intent, even if in the service of hunting.

So where does TLM begin? Arguably, it begins when when a people move beyond passive conservation practices into active cultivation with horticultural intent, or activities aimed actively at altering the landscape to increase hunting efficiency. This describes nearly every technique typically appearing in lists of TLM practices. TLM can be accurately viewed as a subset of the broader category of "niche construction" behaviors. The latter encompasses additional practices including, for instance, the management of wild species of animals and the domestication of animals (Smith, 2012).

TLM in the evolution of HG lifeways

Before examining several questions concerning TLM, it will be helpful to consider briefly how it appears to have fit into the evolution of HG societies. In an important line of anthropological thinking, James Woodburn developed a classification for HG societies, distinguishing between "immediate-return" (IR) and "delayed-return" (DR) systems (Woodburn, 1980, 1982, 2007). As far as we know, for the great bulk of our existence all humans subsisted as IR HGs. IR HGs are oriented to the present. Returns on labor are more or less immediate. (Pick berries, eat some now, take the rest back to camp, and eat them over a day or two.) Such HGs tend toward little food storage and use simple, portable, easily replaceable tools. They live nomadic or semi-nomadic lives in bands (smaller than tribes), and often tend toward egalitarian social organization. By and large, subsistence practices are limited to hunting, gathering, and little else.

Fundamentally different from IR societies, DR HG societies are thought to have emerged in the latter years of the Pleistocene, becoming common by about 10,000 to 15,000 years ago, later in some regions (Chatters, 1995; Gintis, van Schaik, & Boehm, 2015; Hayden, 2014; Henry, 1985; Knauft, 1991; Knauft, 1996; Prentiss & Kuijt, 2004). DR HGs are more future oriented. They invest in work over more time, bringing returns on labor after longer delays, store more food, employ a more complex array of tools, hold rights over material assets (often including land), and usually live less nomadic, more sedentary lives in more permanent settlements, more often in larger groups tending toward a more complex, often more hierarchical social organization. At base, the IR/DR distinction concerns subsistence approaches, and that will be the focus here.

Though not synonymous, other terms overlap with IR and DR. For example, the idea of "complexity," common in the archaeological literature, describes HG societies as "simple" (or "generalized") or "complex," terms overlapping considerably in meaning with IR and DR (e.g., Price & Brown, 1985). The time estimates in the foregoing paragraph rely to some extent on the correlation between "complexity" and DR lifeways.

Although one system will always contain elements of the other, IR and DR are for the most part nevertheless distinct categories, and most HG societies fall clearly within one or the other (Wooburn, 1980, 1982).

What does this tell us about TLM as practiced by HGs? TLM is an inherently DR undertaking: manipulations initiated with time delays in future returns expressly in mind. A number of authors have made this point explicit, placing TLM among the activities distinguishing DR from IR subsistence (Collard, Buchanan, Ruttle, & O'Brien, 2012; Stiles, 2001; Tilley, 1996; Woodburn, 1982). Although bits

of TLM do appear in the practices of some IR societies, it's application in substantial amounts clearly began with DR societies (see also Smith, 2007, 2011). Increases in TLM and associated intensification late in the Pleistocene have been described in contexts including behavioral ecology models and niche construction theory (Bird, Bliege Bird, & Codding, 2016; Smith, 2007).

Advocates' message

Arguing TLM has been beneficial for ecosystems, some authors promote it and maintain TLM is important to a mutually beneficial relationship between humans and the land (e.g., Anderson, 2005; Turner, Ignace, & Ignace, 2000). Clearly, if it might be integral to any ecologically benign human lifeway, it should be examined carefully. Yet an inspection of the literature reveals that much about TLM has received little scrutiny. Much of the related literature makes a case for the value of these practices without substantially addressing possible ecological criticisms or concerns regarding the role of TLM in the growth of human domination of Earth's systems. Yet analysis does reveal concerns. Some emerge on investigating common, broad claims made by proponents arguing the case for TLM.

Questioning claims of ubiquity

Apart from contentions concerning specific ecological effects, proponents make several broad claims in promoting TLM as an ecologically sound subsistence approach. The common theme involves portraying TLM as almost ubiquitous in its reach among human societies, through time, and in its impacts across lands. The claims I will examine are:

1. The use of TLM has been *universal* among past HG societies.
2. The impact of TLM reshaped the landscape, even in the Pleistocene, in almost *all corners* of the globe, turning most areas into a sort of garden of human design.
3. TLM can be traced back *well* into the Pleistocene.

Notice that these assertions, whether accurate or not, tell us little about the ultimate ecological benignity of TLM. By promoting an image of TLM ubiquity, however, they pair with the common assumption that ecosystems everywhere were in excellent condition prior to the advent of agriculture, leading to the conclusion TLM must have done no harm.

Claim 1: Has TLM been *universal* among HGs?

This assertion was addressed in a limited way in the discussion of IR and DR systems. It is instructive to look further by inspecting the ethnographic evidence as well. A related consideration concerns the *amount* of TLM a people may practice. As I will show, some societies have practiced TLM so minimally that it sets them clearly apart from others associated with more extensive practices. Still other groups evidently do no TLM at all.

Anderson (2005) writes:

> Some scholars have speculated that the sorts of protoagricultural practices employed by the indigenous people of California are not only very ancient (perhaps thirty thousand to fifty thousand years old in Africa, Europe, and Asia) but also nearly universal among human cultures." (p. 253)

Anderson provides no citation, but is careful in her wording. Without further qualification, however, such a statement risks leaving many readers with only a memory of some notion that TLM is 50 thousand years old and universal among human cultures. Elsewhere, regarding burning, Anderson (2006) writes, “The use of fire as a land management tool in human history has been universal” (p. 417). It’s a major claim, but is offered without substantiation, so it is worth investigating the evidence.

What can we to make of these claims of universality? Read works by anthropologists who have lived among IR HGs, authors such as James Woodburn (1982), Richard B. Lee (1979), Colin Turnbull (1961), and Frank Marlowe (2010), and you might question such assertions. In their descriptions of several IR societies, such authors mention little that would qualify as TLM. Among those authors, writing about the Ju/’hoansi, the Hadza, and the Mbuti, the only one I had seen mention any TLM was Lee (1979), who described the Ju/’hoansi’s use of fire during late winter and spring to encourage new growth, attracting game to an area. Descriptions of this practice are also found in other works, such as those of Elizabeth Marshall Thomas (2006) who spent extended time with the Ju/’hoansi in the 1950s when they were still living full time as IR HGs. She notes, "This, interestingly, was virtually the only way they manipulated the environment" (p. 39). In the case of the Ju/’hoansi, then, we do see minimal TLM in the form of a single practice. Whether this was a recent adaptation, perhaps an influence of neighbors, or something with an extended history, we don't know.

I found no evidence, in my initial inspections of the literature, of TLM on the part of the Hadza, IR HGs of Tanzania (e.g., Marlowe, 2010). Hadza researcher Frank Marlowe offered directly, moreover, that there appears to be no TLM among their traditional subsistence strategies, with the possible exception of some recent practices resulting from the influences of neighbors. He added that the same was true of many other societies (personal communication, November 27, 2012).

Subsequently I did find one brief mention, in an accounting of Hadza uses of fire, of the contemporary use of grass fires to make way for new growth to attract game (Mallol, Marlowe, Wood, & Porter, 2007, p. 2037). This is the sole mention I was able to find of such a use of fire by the Hadza, a curious fact given the many researchers who have reported first-hand observations of the Hadza. I was unable to locate the source or further detail concerning this mention from an ethnographic description. Querying researchers with expertise in HG uses of fire and with extensive first-hand knowledge of the Hadza revealed that some investigators spending time with the Hadza have seen fires, but have not witnessed firsthand who was setting them, whether the Hadza or some of their agricultural or pastoral neighbors (C. H. Parker, personal communication, June 23, 2016; N. Blurton Jones, personal communication, June 24, 2016).

At the time of this writing then, the paucity of mentions in the literature and of corroborative evidence for this practice suggests the tentative conclusion that if the Hadza do burn for TLM purposes it is likely a minimal part of their subsistence repertoire. Clarification may be forthcoming as researchers plan a study to learn more about anthropogenic fire regimes in the area where the Hadza live (C. H. Parker, personal communication, June 23, 2016). In subsequent searches (e.g., Blurton Jones, 2016), I found no further indication of any TLM on the part of the Hadza. In fact, Woodburn (1980) makes clear the Hadza do even much concern themselves with passive (or active) conservation practices. He provides some detail:

> Those who consume most of their food on the day they obtain it and who are unconcerned about storage, also appear to be relatively unconcerned about conservation and about the planned development of their resources…. The Hadza do not replant any part of the roots they dig up; …in harvesting berries, entire branches are often cut from the trees to ease the present problems of picking without regard to future loss of yield. (p. 101)

Investigating the Mbuti, IR HGs of the Ituri Forest in Congo, revealed only one mention of anything sounding like possible TLM, a reference in a paper by Ichikawa (2001) to the scattering of seeds. I learned from Ichikawa, however, that this is an unintentional byproduct of activities such as collecting, consuming, and discarding (personal communication, May 11, 2015). It is therefore not TLM. I uncovered no other indication of any apparent TLM activities on the part of the Mbuti.

The Ju/'hoansi, Hadza, and Mbuti were the first three societies I investigated, only because I had on hand more material on them than on other IR HGs. Although this was obviously not a random selection process, what it revealed is telling. Viewed through the lens of probability, finding that for all three cases TLM figured minimally or not at all still hints that an absence or near absence of TLM has likely been common among IR HG societies. This is hardly surprising; anything more than minimal TLM would be fundamentally inconsistent with IR subsistence. Other groups I investigated to varying degrees include the Batek of Malaysia; the Maniq of Southern Thailand; the Penan of Sarawak on the island of Borneo; the Baka of Cameroon, Gabon, and Congo; the Aka of the Central African Republic and northern Congo; the Yaka of northern Congo; the Jarawa of the Andaman Islands; and the Raute of Nepal. In every instance I found either little or no indication of TLM. If any TLM was evident it was usually just one, rarely two, practices, often just a step beyond simple passive conservation behaviors. An example is the active reburial of a part of the tuber mentioned above with regard to the Baka. The Raute are one example of another group for which limited investigation, including inspection of detailed descriptions of their foraging and subsistence activities, revealed no indication of TLM (Fortier, 2009; Reinhard, 1974).

It is of course possible I missed some clear evidence of TLM for some of the societies I investigated. But an examination of the literature on individual societies does point to a likelihood of minimal TLM on the part of some IR groups, none at all on the part of others.

A shortcut to further examine the prevalence of TLM among HG societies is provided by a survey by Keeley (1995). Keeley presents a dataset of 96 HG groups overlapping little with groups I mentioned above. Each is rated on factors including protoagricultural (TLM) variables. (Keeley uses a modified version of data from Murdock's Ethnographic Atlas [Murdock, 1967] and his Atlas of World Cultures

[Murdock, 1981].) Included are two variables of interest, a “BRN” and a “SOW” rating (pp. 247-248; see also pp. 250-253):

The BRN rating refers to burning, with ratings ranked as follows:

A. “0” (A society practices no burning at all.)
B. “1” (A society practices burning only for hunting purposes.)
C. “2” (A society practices burning to encourage useful wild plants.)

The SOW rating refers to “planting, sowing, and tending of wild plants,” with ratings ranked as follows:

A. “0” (A society does no planting, sowing, or tending.)
B. “1” (A society plants or sows nonfood plants such as tobacco.)
C. “2” (A society plants, sows, or cultivates wild food plants.)

These two ratings then tell us a great deal about the extent of TLM practiced by a people. At over 20 years old, Keeley’s survey no doubt underestimates, to some extent, the prevalence of TLM. (Compared to the more recent reporting in Deur and Turner [2005], for example, it appears to underestimate its use among tribes of the Northwest Coast of North America.) It should remain useful, nevertheless, as a broad-brush measure.

In the Keeley data, 46 of 96 HG societies receive BRN and SOW ratings of (0, 0), meaning that, to the extent the ratings capture TLM, 48% of societies rated do no TLM at all. An additional 14 societies receive ratings of 1,0, meaning they only burn, and then only for hunting purposes. In some cases this will mean using fire strictly to drive game, a hunting tactic conceptually different from TLM. Accounting for this would increase the percentage of groups understood to do no TLM. If we restricted our examination to IR societies, the percentage would surely increase further. On the other hand, many of the societies rated (0, 0) are found at high latitudes where climatic factors might preclude certain TLM practices. If we subtract the 25 societies at the highest latitudes, leaving those at or below the 55th parallel north, we find 23 of 71 societies, or 32%, practicing no TLM.

A more recent dataset compiled by by Scherjon, Bakels, MacDonald, and Roebroeks (2015) corroborates the observations drawn from Keeley’s. This study concerns the range of uses of fire, perhaps the most common tool of TLM, among extant and historically documented societies, the information drawn from the electronic Human Relations Area Files World Cultures ethnographic database (eHRAF). Included are societies of the subsistence type “foragers,” which in the eHRAF refers to those cultures which “depend almost entirely (86% or more) on hunting, fishing, and gathering for subsistence” (eHRAF User Guide, n.d.). The authors organize 231 mentions of various uses of fire in the database. I examined the data to isolate (a) foragers, and (b) those foragers associated with any use of fire that would fall under the definition of TLM used here. (This task involved some minor imprecision. Multiple entries for “First nation people” necessitated some judgement, using associated text, to identify unique societies. Note as well that the Hopi and Navajo are listed in the data erroneously as “foragers.”) The data thus allow for an approximate accounting of the percentage of the surveyed forager societies to have used fire for TLM. Of approximately 67 forager societies, about 19, or 28%, have done so. Keeley (1995) observes that it is unusual for any group to engage in other TLM practices if they do not also burn for TLM. Thus the

proportion of societies in the Scherjon et al. data engaging in any kind of TLM should only be modestly greater than the 28% found to engage in burning for TLM.

Note as well that the question of interest concerns the percentage of HG societies to have *traditionally* practiced TLM. With regard to recently surveyed societies, we can reasonably assume the influences of DR neighbors on the practices of IR societies have skewed the numbers (see Marlowe, 2002). That is, the percentage of IR societies practicing TLM would have been lower before DR societies were common. Referring to the impacts of contact with agriculturalists, Stiles (2001) makes the same point when he writes, "I would suggest that the anomalies we see in existing h-g groups, in which IR and DR criteria are mixed, are due largely to varying degrees of contact between h-g groups and [agriculturalists]" (p. 53). Indeed, It is reasonable to speculate there was a time when no humans practiced any TLM at all.

On the basis of examination of individual societies and the Keeley (1995) and Scherjon et al. (2015) datasets, it appears claims of TLM universality are incorrect. Though the use of TLM is common, it is not in evidence for some societies, even at minimal levels. This is perhaps unsurprising. The wide variety of adaptations along the "foraging spectrum" (Kelly, 2013) is well known. Beyond some combination of basic hunting and gathering behaviors, we would expect little else to be universal among HGs. Further research would be necessary to develop more precise estimates of the percentages of IR and DR societies in which at least some small element of TLM does appear.

Claim 2: Did TLM remake all landscapes, even in the Pleistocene?

In arguing the case for TLM as ecologically beneficial, advocates commonly claim its impacts were pervasive the world over, in some regions going far back into the Pleistocene. Their argument is made, in part, by implication. They challenge the idea of wilderness, insisting it never existed because all lands were humanized by TLM. Because most people tend to assume all landscapes were in good condition prior to agriculture and the spread of civilization, the conclusion is that the impacts of TLM were benign or beneficial.

With regard to North America, advocates often cite works by geographer William M. Denevan. There is some irony here. As much as anything else, Denevan's (1992) work catalogs environmentally *destructive* impacts of Native American land use, including deforestation, soil erosion, roads, and game depletion. What TLM proponents cite, though, are Denevan's descriptions of a thoroughly transformed landscape. He writes, for instance, "There is substantial evidence …that the Native American landscape of the early sixteenth century was a humanized landscape almost everywhere" (p. 369). Referring to a wide range of TLM practices the world over, and a timeframe "much older" than 10,000 years, Fowler and Turner (1999) say, "Very few environments, if any, are/were truly 'pristine wilderness,' unaffected by humans" (p. 421).

Some other scholars seem to have accepted such assertions. In a lecture, political scientist and anthropologist James C. Scott discusses the uses of fire on the part of HGs and later swidden farmers. Describing a timeframe including and predating Homo sapiens, he says, "Until roughly a hundred years

ago …there was scarcely any part of the globe …that had not been remade by …anthropogenic fire" (SOAS, University of London, 2015).

How reasonable are these claims? It is illuminating to look briefly at analyses, some looking many millennia back into the Pleistocene, which contradict them. They focus on the effects of burning, one of the most common TLM practices and the one with the most extensive impacts.

Burning in North America

The collection, *Fire, Native Peoples, and the Natural Landscape*, examines the evidence concerning anthropogenic fire in North America, especially the West (Vale, 2002a). In it researchers explore fire impacts in seven regions. Their views contrast with those of TLM proponents, illuminating the ongoing debate over the extent of Native American burning. Consistently, these authors conclude the effects of native burning were real but that the evidence does not support claims of widespread remaking of landscapes.

Writing on the Rocky Mountains, for example, Baker (2002) writes:

> In some sectors, it is commonplace today to hear the generalization that landscapes throughout the world were modified by pre-Euro-American people, and wilderness relatively free of human influences did not exist... [with] nearly everywhere transformed by burning, agriculture, and other aboriginal land uses. This generalization is not supported by the available evidence about use of fire by Indians in the Rocky Mountains…. Ignitions by Indians were… probably numerically insignificant relative to lightning ignitions. (p. 41)

Baker points out that accounts of fires from early Euro-American explorers and settlers are unreliable. He details data showing one of the most serious problems to be a consistent failure on the part of such observers to recognize lightning as a major ignition source (see, e.g., Hough, 1882, p. 206). Physical evidence such as fire history analyses based on tree ring data provides more reliable, objective information. Using such data, Baker organizes reports from all published and some unpublished Rocky Mountain fire histories to reveal a picture of marked variability rather than pervasive human impacts. Only in some cases are ignitions from native burning needed to explain fire frequencies (e.g., Arno, 1980). In other cases lightning and weather adequately explain fire frequencies (e.g., Loope & Gruell, 1973, p. 434), or native ignitions were more frequent in more heavily used areas (e.g., Barrett, 1980). Accounting for this variability, Baker concludes:

> Reliable evidence of burning by Indians in the Rocky Mountains is much less than reported previously, as earlier authors uncritically accepted most early Euro-American accounts of burning by Indians, and many studies did not consider and cannot exclude plausible alternative explanations of fire frequency anomalies. (pp. 68-69)

Vale (2002b) summarizes the researchers' conclusions: "Good evidence for pre-European fire histories is spatially uneven in the American West, but in regions where documentation is strongest, the importance

of Indian burning as a vegetation factor at the landscape scale seems weakest" (p. 296). The reality, he argues, is almost the opposite of what many TLM proponents would have us believe: "Moreover, the authors hardly argue for a sort of balance between humanized and nonhumanized components within the landscape mosaic: at least for the effects of anthropogenic burning, the *intensely humanized landscape* seems localized amid a dominating *natural landscape*" (p. 299).

In some instances it is possible to gauge the extent of impacts of native burning via fire history data from before and immediately after its withdrawal. Swetnam, Baisan, and Kaib (2001) report that when the Apache, who Pyne (1982) argues burned for a variety of reasons and in ways "typical of grassland tribes" (p. 519), were removed from areas along the United States border with Mexico, fire frequencies showed no decline for one to two decades prior to the introduction of intensive livestock grazing.

Barrett, Swetnam, and Baker (2005) cite evidence, including their own research, to back their argument that, "The case for landscape-level fire use by American Indians has been dramatically overstated and overextrapolated" (p. 31). They conclude with a fundamental point: "Most accounts of Indian fire use are vignettes allowing little more than speculation about the spatial and temporal scales of burning" (p. 33).

Even for some of the more reasonable assertions, evidence for TLM, including burning, in North America is problematic. It often comes from anecdotal accounts of small sample size and oral histories often relying on second or third-hand memories of the stories of deceased elders from the last century or two. Despite their obvious cultural and historical value, these accounts are often subject to interpretation with a risk of confirmation bias. The basic validity of such accounts, moreover, can be difficult to verify. Though such oral histories can surely contain accurate memories, objective truth may often be obscured by the passage of time (see the discussion in Baker, 2002). It is prudent to resist making firm generalizations on the basis of such information. While respecting the cultural utility of such stories, we can't simply assume historical accuracy. To do so may be tempting, but means turning away from objective inquiry.

We know Native Americans did set fires. The question concerns the *extent* of impacts. Given the tremendous diversity among native tribes at the time of European contact, can there be any doubt the extent varied as a function of culture, landscape, climate, historical events, and other factors? Do claims of humanized landscapes "almost everywhere" promote a homogenized view of indiscriminate burning that ignores native diversity?

Surveying the available information on North America in his essay "The Myth of the Humanized Pre-Columbian Landscape," conservation writer Dave Foreman (2014) offers this conclusion:

> Those early explorers and later colonists who, on the basis of the wilderness they encountered, extrapolated that all of the Americas was a wilderness before Europeans are now imitated by their deconstructors who, on the basis of native-modified spots, extrapolate that all of the Americas was domesticated. Both views are unfounded -- and silly. (p. 117)

Burning in Australia

For continents such as Australia, with earlier human arrival dates than North America, we can examine the evidence for a considerable span of the Pleistocene. At some Australian sites, increases in sedimentary charcoal appear to have formed approximately coincident with human arrival. Some researchers have interpreted such evidence from the charcoal/pollen record as a possible indication of the initiation of large-scale human fire regimes during the Pleistocene (Kershaw, Van Der Kaars, & Moss, 2003; Turney, et al., 2001). In this line of thinking, Aboriginal burning during the Pleistocene was widespread, remaking landscapes on a continental scale, with impacts on vegetation and climate (Miller, Magee, Fogel, & Gagan, 2007). There is debate over whether this evidence points to early human-caused extinctions and ecosystem collapse (Miller, Magee, Fogel, & Gagan, 2007; Murphy, Williamson, & Bowman, 2011).

In an effort to bring more definitive evidence to bear, Mooney et al. (2011) examined charcoal data from 223 sites across Australasia. They conclude, "We have found no evidence of a change in fire regimes at a continental scale at the time of Aboriginal colonisation of Australia (50 +/- 10 ka)" (p. 41). Instead, they argue the dominant driver of changes in fire regimes has been changes in climate. Further, they explain that the "causal association of anthropogenic fire with changes in climate, vegetation or fauna has remained seductive, despite several lines of contrary evidence" (p. 41). Their own findings add substantially to that evidence.

Looking at the last 20,000 years with even larger datasets, Williams, Mooney, Sisson, and Marlon (2015) reach a similar conclusion:

> If evident at a continental or regional scale, anthropogenic burning should be observable as a significant increase in charcoal, reflecting greater numbers of fires lit, or alternatively a sharp decline as more regular mosaic burning reduced the magnitude and size of fires - neither is evident based on our results. (p. 55)

They add, "This…contradicts persistent suggestions of Australian-wide land management and the pervasiveness of the impacts of 'fire-stick farming'" (p. 49).

Burning in Europe

Though burning played a role in the Holocene as agricultural populations deforested much of Europe (Bradshaw, 2004; Vannière et al., 2016), evidence is lacking for large scale burning for TLM purposes on the part of Pleistocene HGs. Daniau, D'errico, and Goñi (2010) examined microcharcoal from deep-sea cores off Lisbon and Bordeaux to assess changes in biomass burning from 70 to 10 thousand years ago. Once again, they found "no major increase in fire regime… at the onset or after the colonisation of these regions by Modern Human populations" (p. 5). They conclude, "At a macro level at least, the colonisation of Western Europe by Anatomically Modern Humans did not have a detectable impact on fire regimes" (p. 7). Again, they found "climatic variability and its impacts on fuel load" (p. 1) was the driving force behind changes in fire regimes.

How little we know

What can we conclude, then, about the assertion that TLM, especially burning, reshaped and humanized the land almost everywhere? I've touched on three continents with analyses running counter to that notion. There are similar findings for other continents (e.g., Salzmann, 2000). There's no question indigenous peoples in recent centuries have used fire and other forms of TLM, sometimes extensively, to alter plant growth patterns. For example, Bird, Bliege Bird, and Codding (2016) describe evidence of a notable increase in anthropogenic burning in Australia's Western Desert commencing in the middle to late Holocene. Evidence for the Pleistocene, on the other hand, is minimal and debated. We don't know the extent of impacts. That said, the available evidence suggests broad generalizations about a globally transformed landscape are, at best, unwarranted.

Given what we do know, it seems reasonable to suppose the reach of anthropogenic burning across the landscape, particularly in the Pleistocene, was limited. At this stage, though, firm conclusions are impossible. This is partly because of the difficulty identifying signs of burning for land management purposes. The gist of the problem lies first in the difficulty of identifying evidence of possible land use practices in the deep past because it involves searching locations away from archeological sites. Then there is the problem of distinguishing between anthropogenic and natural fire. These and other complexities are plainly acknowledged by certain authors in the relevant literature (e.g., Scherjon et al., 2015; Bowman, 2015; Holdaway & Allen, 2015). At present, then, it is remarkably difficult to obtain evidence that allows for firm conclusions about ancient burning for TLM purposes. Objectivity demands we acknowledge that in our discussion of TLM.

Did TLM create vast landscapes?

A related claim goes beyond the idea that humans influenced landscapes, suggesting they fully created what we see across some vast regions. Though some references to "anthropogenic landscapes" seem essentially a figure of speech with implicit recognition of influence rather than creation (see, e.g., Bliege Bird, Bird, Codding, Parker, & Jones, 2008), here I refer to what seems a stronger contention. In recent years, for example, the notion of landscape creation has emerged with regard to the Amazon rainforest. The idea reached a popular readership via a best-selling book (Mann, 2005) in which the author quotes anthropologist Charles Clement saying of Amazonia, "I basically think it's all human created" (p. 344). Similarly, Erickson (2006) writes of Amazonia, "Past peoples constructed and maintained these landscapes" (p. 267), emphasizes that they are "an indigenous *creation*" (p. 237), and refers to "the artificial creation of this landscape" (p. 262).

Critiquing this line of thinking, Bush and Silman (2007) warn of "uncritical acceptance of Amazonia as a manufactured landscape" (p. 457). They observe that the data on which the idea is based come from only a few locations chosen without random or systematic sampling.

Piperno, McMichael, and Bush (2015) analyzed phytoliths in western and central Amazonia. They report, "there is little to no evidence for human occupation and vegetation disturbance in the terra firme locales

and in some of the riverine areas sampled" (p. 1590). Their data "support previous conclusions (McMichael et al., 2012b) that these forests were little modified by prehistoric human activity" (p. 1592). They conclude, "The large-scale vegetational and other impacts previously proposed (e.g. Dull et al., 2010; Erickson, 2010; Nevle et al., 2011; Wood quoted in Romero, 2012) appear to be in need of reassessments" (p. 1595).

Even apart from such research, the erroneous nature of the contention that humans created the Amazon forest is self evident. The origins of the Amazon rainforest are traced back some 55 million years. It's form has varied in an interplay, for instance, of forest and savanna features, the major changes driven by such forces as climate and tectonic instability (Maslin, Malhi, Phillips, & Cowling, 2005; Jaramillo et al., 2010; Carson, et al., 2014). There is little question humans had impacts on the Amazon region, building earthworks and influencing soils and plant life in some riverine and other locations. But the idea promoted by some researchers that humans *created* the region seems an extreme exaggeration.

Discussions of native impacts on large grasslands sometimes produce claims as extravagant as those concerning Amazonia, with some arguing the Great Plains and other grasslands were "created" or "manufactured" by regular native burning (e.g., Pyne, 1982). Anderson (2007) writes, "Most if not all of the great grasslands of the world …were maintained by fires set by native peoples" (p. 57). Noss (2013) reponds, noting a lack of evidence provided for such a view, and points to measurable evidence of the primary importance of lightning fires in maintaining the grasslands in question, and paleoecological findings indicating millions of years of existence for grasslands in North America. He summarizes: "History shows that savannas and other fire-dependent ecosystems arose long before humans began using fire" (p. 204).

Vale (2002b) responds similarly to the claims the Great Plains are a human creation:

> The data from a variety of paleoecological studies clearly indicate otherwise: long before humans invaded the continent, "the glacial-age vegetation of the southern Great Plains was a grassland" (Hall and Valastro 1995:237); "the Southern High Plains has been primarily a grassland …throughout most of the Quaternary" (Holliday 1987:242). (p. 297)

The notion that humans created most grasslands should be treated skeptically, as the extraordinary claim it is. Noss (2013) puts it simply: "Those who have convinced themselves that humans created virtually all grasslands would do well to reconsider their position in light of climatological and paleoecological evidence" (p. 204). Native peoples on the Great Plains and other grasslands did engage in burning. But, as with assertions concerning Amazonia, some realistic, modest influence on a landscape does not warrant claims of "creation" or "manufacture."

It's worth noting that the exaggeration involved in suggestions of human creation of the Amazon rainforest or of the world's major grasslands has been influential outside the scientific community. It supports a trend among those environmentalists some call "ecomodernists" or "anthropocene boosters" to cast everything in human terms. Wilderness, they argue, is a "human creation" (Cronon, 1996, p. 7). This view becomes essentially the same line of thinking suggesting that if humans had some influence on a

landscape, then humans created it (see the discussion in Kidner, 2014). Not surprisingly, ecomodernists contend it is our place as humans to manage nature, and so the earth (Kareiva & Marvier, 2012; cf. Wuerthner, Crist, & Butler, 2014). One topic largely ignored in the ecomodern argument is the question of the condition of various landscapes before human arrival, or before the initiation of substantial amounts of TLM. I will look further at this in a future paper (Feeney, 2016).

Can TLM be traced back well into the Pleistocene?

I touched on this question with regard to fire regimes in Australia. There is more to consider, however, regarding the comments, mentioned above, from researchers such as Anderson (2005, p. 253) and Fowler and Turner (1999, p. 241) suggesting a range of TLM practices go back well into the Pleistocene, perhaps as far as 50,000 years. Postulating that any collection of practices goes back 50,000 years goes beyond current evidence. What evidence there is in the range to which these authors point concerns the possibility of anthropogenic burning. We can glean from it hints of the possible use of fire for TLM, but not indications of a repertoire or collection of TLM practices.

At some sites in South Africa and New Guinea, for example, signs of burnt vegetation are dated as far back as the range these authors suggest. Some interpretations of this evidence have included speculation concerning the possibility of human-initiated burning for land management purposes (Denham & Barton, 2006; Mellars, 2006). In Germany, charcoal evidence correlated with Neandertal presence has prompted conjecture about the possibility of the use of fire for forest clearing (Roebroeks & Bakels, 2015). These interpretations are acknowledged as speculative, with other hypotheses concerning natural ignition sources remaining active (Pop & Bakels, 2015).

Aside from such intriguing hints, there is little tangible evidence of TLM from most of the span of the Pleistocene. Smith (2007) summarizes:

> The very early domestication of utilitarian species such as the dog and bottle gourd, along with tantalizing evidence of possible deliberate burning of vegetation, provide most of the admittedly limited direct evidence that human societies were active ecosystem engineers well back into the Pleistocene. (p. 196)

Note as well that the reference to the bottle gourd concerns its domestication 12,000 to 15,0000 years ago (Smith, 2007). Does any collection of TLM practices go back as far as 50,000 years? For now, the available evidence does not warrant such a conclusion. Though anthropogenic burning may be that old, current evidence is ambiguous, with confirmation awaiting further research. A TLM repertoire and its use in substantial amounts is essentially a DR undertaking, and therefore unlikely to have appeared before the latter years of the Pleistocene.

Discussion

A modicum of scrutiny suggests TLM was not as pervasive among human societies or in remaking landscapes as some authors have suggested. Any conclusion about its age is premature, but because it

involves a collection of essentially DR practices, it seems safe to say it was not practiced in substantial amounts before the latter years of the Pleistocene. None of this should be construed to suggest the impacts of TLM were not considerable. Both direct ecological impacts and long term consequences deserve careful scrutiny, a process already underway. Indeed, mounting evidence suggests long term consequences were profound, the intensification of ecosystem manipulations in the late Pleistocene providing much of the impetus needed to initiate and extend the early stages of human domination of Earth's systems (e.g., Bird, Bliege Bird, & Codding, 2016; Smith & Zeder, 2013).

Analyses of direct ecological impacts of common TLM techniques and strategies can be found piecemeal in the ecological and anthropological literature. There would be value in bringing together these findings to provide a more cohesive picture of the impacts of this key approach to subsistence. Also of interest would be an exploration of the interplay between changes in the human worldview triggered by the shift from IR to DR lifeways and the intensification of TLM over the same period (see, e.g., Berman, 2000; Martin, 1999).

In examining the ecological impacts of human lifeways, TLM deserves special attention. Its application represents the first substantial manipulations of ecosystems by human societies, manipulations we should seek to understand as fully as possible. With a more accurate picture of the reach of TLM among human societies, through time, and across landscapes we should be better positioned to explore more effectively the relevance of the deep past to the human future.

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