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Yards, Corridors, and Mosaics: How to Burn a Boreal Forest[1]

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Ethnographic studies have established that, until shortly after World War II, Indians in northern Alberta regularly and systematically fired habitats to influence the local distribution and relative abundance of plant and animal resources. In ways similar to what has been reported for hunter-gatherers in other regions, this pyrotechnology contributed to an overall fire mosaic that, in this case, formerly characterized northern boreal forests. Cross-cultural comparisons of these practices with those in other parts of North America, as well as in several parts of Australia, illustrate functionally parallel strategies in the ways that hunter-gatherers employed habitat fires, specifically in the maintenance of "fire yards" and "fire corridors" in widely separated and different kinds of biological zones.

KEY WORDS: hunter-gatherers; fire technology; fire ecology; North American Indians; Australian Aborigines.

INTRODUCTION

The term "fire mosaic" refers to the ways that environments, in this case northern boreal forest ecosystems, are affected by fire, the one element

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acknowledged as the principal factor for both changing and maintaining communities of plants and animals. Heinselman (1971) describes fire mosaics as the original condition underlying the evolution of natural environments.

> The primeval landscape was a vast mosaic of stands in various age classes and successional stages following fires, interspersed with recently burned areas. (p. 61).

Fire mosaics are shaped and structured by a complex set of factors that include such variable conditions as the seasonality of burning, the frequency and intensity of individual fires, topography, fuel types and fuel diversity, the size of areas burned, the build-up of fuels, the conditions and fire histories of adjacent stands, and even the ecology of animals in affected areas. Studies in fire ecology can have considerable significance for anthropologists in that they reveal how fire-influenced environments are especially well suited to hunting and gathering, showing that periodic fires can have important short- and long-term benefits.

> . . . any influence tending toward diversifying the landscape at large and small scales will *increase the diversity of the fauna as well as the population density of some species.* By maintaining a mosaic pattern in the boreal forest, fire assists in the maintenance of diverse wildlife populations. . . . The pattern and scale of burned and unburned patches is probably critical in determining the suitability of habitat for many species (Rowe and Scotter, 1973, p. 458, emphasis added).

Fires and the resulting fire mosaics are caused by effectively random natural events (almost always lightning) and (to varying degrees) scheduled human activities. There is, however, an important difference in magnitude between naturally and artificially affected mosaics, specifically, as quoted above, in the "pattern and scale of burned and unburned patches." Natural fire mosaics are characterized by larger, less frequent but usually hotter burned stands of vegetation; man-made fire mosaics, at least those fire-maintained by hunter–gatherers, entail smaller, more frequently, and lightly burned patches of growth. This is largely a consequence of the fact that hunter–gatherer fires differ from natural ones in terms of the seasonality and frequency with which they are set, and they are set in selected areas under essentially safer, managed conditions (Lewis, 1982b).

In our previous studies on northern Alberta (Ferguson, 1979; Lewis, 1977, 1980, 1982b, 1985a), the working assumption about the broader consequences of Indian burning within the boreal forest region was that it represented an essentially small-scale, albeit more complex and intensified version of a natural fire mosaic. Our thinking was very much influenced by the interpretations of fire ecologists from such works as the Canadian Wildlife Service's compendium, *The Effects of Fire on the Ecology of the Boreal Forest* (Kelsall, Telfer, and Wright, 1977). This and more specifically focused studies provided us the biological background to our ethnographic inquiries and subsequent interpretations.

However, as a result of more recent research by us in Australia (Lewis, 1985a,b) and current studies in Wood Buffalo National Park (Ferguson, 1986), it appears that our working assumption about the pattern of man-made fire mosaics in northern Alberta was far too simple in seeing it as merely a more complex and intensified version of natural mosaics.[3]

A more appropriate model for illustrating the pattern of man-made fires in Alberta's boreal forests is suggested from examples of how foragers used habitat burning in other parts of the world, particularly in how fires have been employed in more-or-less marginal environments in which primary productivity is relatively low. An area previously considered for indigenous burning practices is the Coast Range of northern California (Lewis, 1973, pp. 60-70), a region of limited natural resources (Baumhoff, 1963, p, 176). The characteristic burning strategies found within this region involved the maintenance of what we call *fire yards* and *fire corridors.*

> . . . *the most consistent pattern to emerge is that of summer burns in the higher elevation grasslands* [fire corridors] *of the coastal coniferous forest,* particularly in the inland areas away from the heaviest concentrations of redwoods. *Almost as consistent and certainly the most dramatic pattern to appear is that of opened grass "prairies"* [fire yards], *apparently within all elevations of the redwood and pine-fir sub-types in the northern Coast range.* What these two patterns strongly indicate is the fact that the *Indians of this region had made a use of fire which involved a technologically sophisticated control of natural resources in a region in which the particular resources of forest plants and animals which they sought were not in great abundance* (Lewis, 1973, p. 70, emphasis added).

As shall be seen, like patterns are (or were) maintained in a variety of environmental settings and by culturally unrelated groups of hunter-gatherers in quite disparate parts of the world, and all in areas of resource scarcity. In reassessing our work on the Indian fire regimes of northern Alberta, we feel that the following examples of hunter-gatherer uses of "fire yards" and "fire corridors" provide a much sounder comparative basis for constructing a more realistic model which will enable us to better interpret the consequences of indigenous burning practices in boreal forests and other like regions of limited natural resources.

PRESCRIBED BURNING AND THE "FOREST PRIMEVAL"

Sounding somewhat contradictory, it is now accepted wisdom among fire ecologists that *prescribed fires* should be used to establish *natural fire*

[3]These differences and the considerable evidence on Indian fire technologies in northern Alberta can be found in Ferguson (1979) and Lewis (1977, 1980, 1982a, 1982b, 1985a).

mosaics, at least in wilderness areas and in national parks where the goals and practices of fire management are somewhat more easily realized (Lotan, Kilgore, Fischer, and Mutch, 1985). The desirability of fire management practices for northern boreal forests has been put forward by a number of writers, with a recent review and evaluation of published studies by Alexander and Dube (1983). However, much of what is today designated as "wilderness" was once exploited and manipulated with fire by North American Indians, just as the areas that are now farms and cities once were (Pyne, 1985).

The "virgin lands" first observed by Europeans in the sixteenth and seventeenth centuries were not an untouched wilderness. As several writers have noted, the "forest primeval" was a later, romanticized creation of the Euro-American imagination. The forests, parklands, and prairies of North America had already been greatly influenced and actively managed by aboriginal peoples' widespread uses of fire (Day, 1953; Stewart, 1954; Pyne, 1982, 1985). The goals of Indian uses of habitat fires were predominantly technological, with the added awareness that fire is a tool of enormous potential and that it has complex and important ecological consequences (Lewis, 1985a).[4]

In addition to a number of ethnographic and ethnohistoric interpretations on North American Indian uses of fire, there is a significant body of comparable data on Australian Aborigines.[5]

Though the tropical and temperate rainforests, monsoon savannas, spinifex deserts, mulga scrubs, and eucalypt woodlands of the Australian continent are markedly different from North American biomes, the similarity of ways whereby culturally and geographically distinct peoples have fire-managed these habitats is most impressive (Lewis, 1982a). Thus, though the boreal forests of northern Alberta could not be much further removed from the temperature rainforests of southwestern Tasmania, the respective strategies in fire management are remarkably parallel.

"FIRE YARDS" AND "FIRE CORRIDORS"

The meanings implied in our use of the terms *fire yards* and *fire corridors* are self-evident: fire yards are the openings or clearings (meadows,

[4]Whether or not Indian uses of habitat management were "ecologically sound" or "environmentally destructive" is not at issue here, and there is certainly no reason to assume that all Indians employed fire equally or effectively, however one defines "equally" or "effectively." Nonetheless, most of what North American Indians did with respect to affecting local environments appears to have worked effectively, over long periods of time, for hunting and gathering adaptations.

[5]The list is too long to detail here, but for most references to indigenous uses of fire in Australia, the reader can consultant articles by Hallam (1985) and Lewis (1985b).

swales,[6] and lakeshores) within a forested area that are maintained by burning, while fire corridors are areas similarly maintained which make up the grass fringes of streams, sloughs, ridges, and trails. As several of our interviews revealed, both yards and corridors can be created by selected uses of fire if plant and edaphic conditions are appropriate, and both types of areas are places in which animals alternately collect or traverse. For foraging peoples, the existence of fire yards and fire corridors provides both a greater abundance of plant–animal resources and a higher measure of hunting predictability.

Northwest California

The Indian inhabitants of northwest California, specifically those residing within the redwood forest belt, followed a pattern of firing open areas within the forest and along grass-covered ridges. These "anthropogenic prairies," as one writer describes them for western Washington (Norton, 1979), were regularly burned in order to attract game from surrounding, densely-forested areas, mature forest stands that were purposefully left unburned or at least subjected only to infrequent lightning or accidental man-made fires. As noted above, the region as a whole is described as one of relative resource scarcity which, by comparison with nearby regions, had an overall lower level of primary productivity (Baumhoff, 1963). Throughout the California Coast Range, fires were used to maintain fire yards and fire corridors rather than allow these areas to be invaded by brush and trees. The resulting pattern was described by Loud (1918) for the Wyot Indians in what is now Humboldt County:

> *Within the forests, at all elevations from sea level to the top of the ridges, there were small open patches, known locally as "prairies,"* producing grass, ferns, and various small plants. These prairies are too numerous to mention in detail.... *Most of these patches if left to themselves would doubtless soon have produced forests, but the Indians were accustomed to burn them annually* so as to gather various seeds, especially a species of sunflower.... The statement of Professor Jepson that "there is today more wooded area in Humboldt County than when the white man came over a half a century since," was confirmed by reports made to the writer that some of the old prairies had come up to young growth of forest. *These prairies were of incalculable value to the Indians, not alone for their vegetable products, but also for the game found upon them. A sharp contrast is drawn between the animal life in the forests and on these prairies....* (pp. 230-231, emphasis added).

Thus, the "prairies" (fire yards) and ridge tops (fire corridors) were areas to which animals were attracted and where they were successfully hunted.

[6]The word swale actually derives from the Old English *swelan,* to burn.

This pattern is strikingly different from what was carried out on the inland side of the coastal ranges, and by some of the same Indians, in drier, more resource-productive Douglas fir–ponderosa pine forests. It also differed significantly from the overall strategies of burning employed by Indians in the interior coniferous forests of the Sierra Nevada and Cascade Ranges where understory burning was employed and a more characteristic mosaic pattern was maintained (Lewis, 1973, pp. 60-70).

Traditional burning practices were still recalled by a few northern California Indians as recently as the early 1970's. In a "personal communication" from Richard A. Gould (quoted in Lewis, 1973), the Tolowa and other Indians of northern California and southern Oregon are noted as having burned selected areas and employed practices similar to those described for the 1800's and early years of this century:

> The term, prairies, for the clearings in the redwood forest areas of northern California is really inappropriate, since most of these clearings are very small (the largest one I ever saw was only about ¼-mile long, and most are much smaller than that).... *The Indians* (here I include Tolowa, Tututni, Yurok, Karok, and Wyot) *did burn these areas over fairly often, and I think it would be fair to suggest that this burning helped to maintain these areas by inhibiting the growth of brush and trees.* These "prairies" —in all cases I have seen—did not contain any village or habitation sites, *since they lie within a zone of extremely poor natural resources for that region. However, these clearings are frequented by elk and deer, which the Indians there hunted whenever they could* (p. 69, emphasis added).

Finally, a forestry account from the 1930's notes the pattern for the region as a whole:

> The stories of old residents of the redwood region concerning the acts of the Indians are conflicting. Some believe that the Indians set the woods afire every season that there was a sufficient accumulation of litter to support a fire—every four or five years —and that *the course of an Indian travelling through the woods could be charted from a distance by the succession of smokes as he set fires.* Others say that the Indian was afraid of fire and set it only to drive game or to burn out his enemies, or that his prairie fires escaped into the woods (Fritz, 1931, p. 939, emphasis added).

Western Washington

A similar picture has been presented for western Washington by Norton (1979) who, working with a more limited number of historical accounts, goes on to include supporting archeological and botanical materials. Norton's thesis that the prairies and grasslands of western Washington are essentially anthropogenic is convincing and it is further strengthened by the functionally equivalent examples that are presented here. Unfortunately, she presents no historical examples of what we call fire corridors.

While noting that the observer's comment about deer and elk as grazing "fern sprouts" is probably wrong, Norton includes an example for the Quileute Indians of Cape Flaterry for what it says about the frequency of burning and the kinds of areas involved.

> The burning of the fern year by year was what kept up the "prairies" of the peninsula and extended these areas. The Indians burned the ferns for the purpose of clearing out the prairies so they could shoot the deer and elk when they came to feed on the young "fern sprouts" (as quoted in Norton, 1979, p. 178).

More impressive is the description provided by a mid-nineteenth-century observer in the Puget Sound area:

> A few remarks are necessary upon the origin of the *dry* prairies so singularly scattered throughout the forest region. *Their most striking feature is the abruptness of the forests which surround them giving them the appearance of lands which have been cleared and cultivated for hundreds of years*.... The Indians, in order to preserve their open grounds for game, and for the production of their important root, the camus, soon found the advantage of burning.... On some prairies near Vancouver and Nisqually, where this burning has been prevented for twenty years past, young spruces are found to be growing up rapidly, and Indians have told me that they can remember when some other prairies were much larger than at present (partially quoted from Norton, 1979, p. 179, emphasis added).

A reference to Indians fire in western Washington that was not available to Norton refers to large-scale burning on Whidby Island north of Seattle. This involved the annual firing of the "greater portion" of the island's some 40,470 ha (Moravets, 1932). Though effectively grasslands, the island was rapidly taken over by Douglas fir after the Indians were driven out by white settlers between 1850–1860.[7]

That the following description departs somewhat from the pattern of burning fire yards or fire corridors in western Washington merely reflects the fact that hunter–gatherers varied their practices in terms of perceived needs *and* local environmental conditions:

> Whidby Island, once largely deforested by the Indians' repeated "light burning," is now well forested with second growth Douglas fir. It is a striking example of the ability of Douglas fir quickly to reclaim lands long scourged by fire, after the periodic burning ceased.... Many of the Puget Sound Indians used the island for a hunting ground.... Deer were plentiful and large portions of the island were burned over annually to make better hunting. [My informant] recalls the time when areas now forested were treeless grass plains (Moravets, 1932, p. 3).

[7]I am grateful to Martin E. Alexander, Northern Forest Research Center, Canadian Forestry Service, Edmonton, for bringing this reference to my attention.

Australia

Hallam's recent paper, "The History of Aboriginal Firing" (1985), is a comprehensive critique of traditional aboriginal burning practices in Australia. Her main concern is to refute several earlier studies which maintain that aboriginal fires had little or no effect upon the Australian landscape (Clark, 1981, 1983; Nicholson, 1981) or differed little in terms of results from natural conflagrations (Horton, 1982a,b). In her counter-argument, Hallam brings together numerous examples of how Aborigines from various parts of the continent used habitat fires to demonstrate what she sees as a "fine-grain mosaic" effect and the considerable impact that aboriginal burning technology had on natural environments.

Referring to her earlier work (1975), that of other researchers (Jones, 1969, 1975; Kiernan, Jones, and Ransom, 1983; Lewis, 1982a,b; Lourandos, 1983; Tindale, 1959), and a relative wealth of historical source materials, she points out that fires were set in a variety of ways related to an overall set of climatic and environmental factors. She demonstrates that, in spite of important differences in the vegetational zones of Australia, as well as local differences in habitat types, there are basic similarities in the ways that Aborigines fired "marginal places":

> Fire, then, could be most effective in marginal places—near the margin of the tropical rainforest (as at Lynch's Crater [Queensland]), or the eastern margin of the jarrah forest, as in Western Australian ethnohistorical sources, [and] in creating sclerophyll woodland in northwest Tasmania. *Firing could not and did not bring about major change in the core of the* [northern] *Queensland rainforest, the heart of the karri* [Western Australia], *the depths of the wet Tasmanian southwest.... It could and did create "clear patches" on the Bunya Mountains* [southern Queensland], *grassland corridor along valleys through the jarrah (e.g. the Chittering Valley or the Wooroloo Brook* [Western Australia]), *or maintain sedgeland corridors from the Cradle Mountain uplands to the coast in Tasmania* (Hallam, 1985, p. 15, emphasis added).

Tasmania

As compiled from a number of sources, the Australian historian Blainey (1976) has described the overall impact of aboriginal fire technologies in Tasmania:

> The rainforest and its tangled undergrowth on the west coast is sometimes called "primeval," and the grassy valleys in the midlands are sometimes likened to an unchanged Garden of Eden...but it can scarcely be called primeval [since] in aboriginal times it was relatively open country and sufficiently grassed to attract game. *Other parts of the thick rainforest of the west coast were dissected in aboriginal times by tracks kept open by repeated burning;* when the Tasmanian aboriginals vanished the forest closed in, and ironically the tourist literature now describes it as impenetrable forest, parts of which have never been explored. There is strong evidence that some of the button grass plains and the sedgeland on the west coast, some of *the grassy*

> *patches at the headwaters of the north-flowing rivers,* and the parkland or grassland of the midlands were the result of the persistent burning by the Tasmanian aborigines (p. 79, emphasis added).

Throughout the environmental zones of Tasmania, aboriginal burning resulted in a combination of yards, corridors, mosaics, and open grasslands. Like the temperate rainforests of northwestern America and western Canada, much of Tasmania is a poor region for hunting-gathering under natural conditions. Jackson (1968), whose work influenced that of Jones (1969), points out the singular importance of fire in facilitating the growth of grasslands and its correlation with the relative abundance of animal life:

> *The regeneration after fires provides the conditions for rapid increases in animal populations* and the sclerophyll communities which they engender provide the niches for a wide spectrum of organisms. *Without fires this region of high rainfall would be almost destitute of animals.* Mature rainforest supports very little higher animal life and has virtually no forms which are specifically adapted to life within it. On the other hand, the sclerophyll communities carry a wide variety of crustaceans, insects, birds, reptiles, monotremes and marsupials (p. 9, emphasis added).

New South Wales

In other parts of Australia, Aborigines seasonally traversed a mix of habitat types which, when taken together, involved burning a combination of yards, corridors, mosaics, and open grasslands. As in Tasmania, but on a much smaller scale, the maintenance of yards and corridors appears to have been directly related to the relative abundance of natural resources in particular habitats. An equivalent pattern of burning yards and corridors within a less productive habitat type was described by the explorer Leichardt (1847) for the narrow coastal belt of wet sclerophyll forest between Morton Bay (Brisbane) and Port Jackson (Sydney):

> The natives seem to have burnt the grass systematically along every watercourse and around every waterhole in order to have them surrounded with young grass as soon as the rain sets in.... Long strips of lately burnt grass are frequently observed, extending for many miles along the creeks. The banks of small, isolated waterholes in the forest were equally attended to.... It is no doubt connected with the systematic management of their runs, to attract game to particular spots (p. 354).

Just inland from this, the country was a mix of habitat types. In an article, "Vegetation of the Sydney Area: 1788 and 1961," Burrell (1980) describes the combination of open forest, "impenetrable thickets," grassy woodlands, and treeless areas in and about Port Jackson, and notes the widespread practice of Aboriginal burning. The Sydney area itself she describes as where "the trees were up to 30 m high, the forest or woodland lacked underwood and there was abundant tufted grass" (1980, p. 75). As these comments indicate, at the time of contact, the Sydney area was a park-

land where Aborigines burned understory grasses. At the same time, these parkland areas were adjacent to the coastal sclerophyll forest within which they maintained fire yards and fire corridors.

The explorer Major Thomas L. Mitchell (1848) noted when passing through the Sydney area in 1836, long after the Aborigines had been eliminated, that:

> The omission of the annual periodical burning by natives, of the grass and young saplings, has already produced in the open forest lands nearest to Sydney, thick forests of young trees, where, formerly, a man might gallop without impediment, and see whole miles before him. Kangaroos are no longer to be seen there; the grass is choked by underwood; neither are there natives to burn the grass, nor is fire longer desirable there amongst the fences of the settler (p. 413).

Western Australia

As Hallam has detailed in her work on traditional uses of fire in Western Australia, burning patterns varied from area to area, not randomly or haphazardly but directly in terms of the environment, from micro-habitats to vegetational zones, and the relative abundance of resources. However, in setting forth her argument vis-à-vis Horton's (1982a,b), she makes the same assumption that we had made about fire mosaics in the boreal forest. Her essential argument is that Aborigines carried out "mosaic burning" and that the equivalents of yards and corridors were *components* of that mosaic pattern.

In regions such as the southwest part of Western Australia, where Aborigines moved in and out of areas of variable productivity, it is, at one level, quite reasonable to consider the *combined results* of burning forest understory, fire corridors, fire yards, and prairie fires as constituting a "fine-grain mosaic" (Hallam, 1985, p. 17). Doing so, however, misses the broader, comparative implications of burning fire yards and fire corridors. Hallam's portrayal of a "fine-grain mosaic" applies most aptly to the environmental effects of hunter-gatherer practices in the monsoon savannas of the Northern Territory.

Northern Territory

In the monsoon savanna region of the Northern Territory, the only areas not burned every 3–4 years are the small stands of tropical rainforest, paperbark swamps, and mangrove tidal flats. These areas of less fire-adapted vegetation are productively different from surrounding habitat types rather than being marginal. Given their importance and their susceptibility to damage, they are fire-protected and left unburned (Haynes, 1982, 1983). Usual-

ly no more than a few hectares in size, the small stands of fire-guarded rainforest contrast markedly with the aboriginal burning of almost all floodplains (90% and more), large sections of eucalypt woodlands (50% and more), and tall open forests (30–35%), and escarpment vegetation (highly variable), all of which truly constitutes a regional fire mosaic (Haynes, 1982, 1983; Lewis, 1985a,b). In the Northern Territory, whether monsoon tropics or central deserts, there is little aboriginal burning that fits the pattern of fire yards and fire corridors.

Aborigines did, and in some remote areas still do, create corridors in desert regions through which they passed leaving more remote areas unburned. However, the scale of the burned areas is much greater and they are not created or maintained in the same way or for the same purposes as are the fire yards and corridors in temperate rainforest areas. Various researchers in the central deserts have stated that Aborigines show little concern with whether or not fires carry into old growth, unburned areas within their own territory. This apparent casualness contrasts markedly with the protection of small rainforest stands in the north.

From an examination of ethnographic and ethnohistoric data on North America and Australia, it seems evident that hunter–gatherers, whether living in marginal environments or only visiting less productive habitats, have developed paralled strategies for managing the relative abundance and regional distribution of plants and animals.

Northwestern Alberta[8]

The vegetation of northwestern Alberta changes progressively from where the Peace River enters the northwestern part of the province west of the small farm town of Hythe (55 20N) to where it empties into Lake Athabasca and the Slave River near Fort Chipewyan (58 46N) in the northeast. Along its course, there are a number of large prairies and aspen parklands, which were, at the time of contact, kept open by Indian practices of burning.

Today, most of these areas include the prairie farmlands surrounding the towns of Grande Prairie, Valleyview, High Prairie, Spirit River, Fairview, Grimshaw, Peace River, and others. Further north, the prairies are smaller and more intermittent at places like Manning, Paddle Prairie, Carcajou, La Crete, and Fort Vermilion. All of these prairies are associated primarily with solonetzic soils which have a high content of exchangeable sodium or magnesium (Reeder and Odnysky, 1964). In many places, the soils have become less saline due to leaching, a process known as "solodization."

[8]References for the following are drawn from Lewis (1977, 1982a) and Ferguson (1979).

Current speculation suggests that the initial salinization of these soils dates to the period immediately following deglaciation. Solodization would then have occurred at a rate dependent on both local and regional factors such as the height of the water table, the development of an integrated drainage, etc. (S. Pawluk, personal communication). With loss of soil salinity, fire would have become an important factor in maintaining these prairies.

There are few historical references to Indian burning on the prairies of the Upper Peace area of Alberta. However, the most extensive of these, by George M. Dawson, a biologist with a Canadian Pacific Railway survey party in 1879, points to the critical role of native burning in maintaining these prairies. He also argues that this burning was instrumental in producing these prairies in the first place, an assumption which in light of the above is questionable:

> Whatever theory be adopted, and may have been advanced, to account for the wide prairies of the western portion of America further to the south, the origin of the prairies of the Peace River is sufficiently obvious. There can be no doubt that they have been produced and are maintained by fires. The country is naturally a wooded one, and where fires have not run for a few years, young trees begin rapidly to spring up. The fires are, of course, ultimately attributable to human agency, and it is probable that before the country was inhabited by the Indians it was everywhere densely forest-clad (Macoun, 1882, p. 125).

From the British Columbia border to Fort Vermilion, Indian burning practices seem to have differed primarily in the total area burned, largely a function of the amounts of prairie grasslands and parklands. In the west, at the time of contact, this probably ranged from 30–40% of the Grande Prairie–Peace River region to a much smaller total in the Fort Vermilion area of 2–3%.[9]

Away from the Peace River and its major tributaries, and in all of the region east of Fort Vermilion, the "prairies" are little more than large meadows, usually adjacent to native settlements, and the soils are those characteristic of the northern boreal forest. Within the boreal forest itself, there are still smaller, more widely scattered meadows. In the boreal forest areas further north, some of which Indians continued to burn as late as the early 1950's, the places most frequently mentioned as being fired were meadows: "hay meadows" near settlement areas and smaller meadows and swales scattered variously throughout hunting and gathering territories. In addition to these, fires were set along traplines and trails, around lakes and ponds, and within windfall or deadfall forests. A Beaver woman described the general patterns of burning in northernmost Alberta in some detail:

[9]These estimates are roughly based on the amounts of grasslands and farmlands in the two areas.

> They used to burn places where they think it was very useful. Like, for instance, the places where the horses used to winter in order to have plenty of good feed for them on grass; and then where there's lakes, around lakes, where there's muskrats, so that [the muskrats] could always have real fresh roots. Places where there's moose and where the moose usually like to roam around; they burn the brushes there so that they'll have good green leaves and things to live on in summer.
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> They used to start burning when there was still snow, here and there, and some of the youngsters just ride on horses and they set matches, you know. That's how they burnt. They don't wait until its really dry because its dangerous. And, lighting [the grasses on] traplines there will be just about two of them and yet the fire's not dangerous. They just burn the areas they want. And, places where the Indians live close to, there'll be brushes like you see around, poplars growing in one place, eh. That's where they used to burn.
>
> Sloughs, where there's muskrats, that's where they used to burn. And where there's heavy brush, like a windfall and things like that, all of the young trees would grow, to attract the animals like moose. Where there's timber and moss they don't burn, of course, because the fire lasts and lasts and it's not good for fur bearing animals like pine martens and mink and lynx; that's where they mostly stay in winter, so they don't want to destroy that. They must be very wise, eh? Those people? That time?

In the more southern and western parts of the Peace River Basin, the overall fire mosaic at the time of contact would have been composed of large areas of prairies and parklands, fringed to the north, south, and east by large, variously aged stands of boreal forests. Toward the north and as far east as Fort Vermilion, this would have gradually changed to more limited areas of smaller prairies and large meadows. Throughout the whole region, surrounding the prairies and parklands in the south and the meadows and forest openings in the north, there would have been a mosaic of forest stands primarily caused by natural fires.

Away from the small prairies and meadows, Indians fire-managed the plant and animals resources associated with trapping and trapline hunting. Traplines generally follow the meandering courses of creeks and sloughs where grasses provide food for herbivores, animals as disparate in size as mice and moose. The abundance and variety of these species directly influences the numbers of predators, the fur-bearing species, and fires were used throughout the drainage areas of the boreal forest to affect the relative abundance of both. As an elderly Slavey trapper from the Hay Lakes region described it:

> In times past, people knew where to trap animals—mink, weasel, marten, lynx, lots of kinds. It makes a lot of difference for the trapper if an area was once burned. People know where to hunt. Our people have a name for those burned places in the forest called *go-ley-dey*. They tell one another about those places and when to hunt there.

The timing of these burns was related to the return of fur trappers in the early spring, when the grassy areas were sufficiently dry and the surrounding forests were still too wet to burn. In some cases, where grasses had not sufficiently dried, Indians would set and leave campfires with one or more

smoldering logs extending into the grasses; these delayed fuses would later ignite the area, sometimes days after their departure. As one Indian trapper noted:

> When we'd come off trapline it might be too wet to burn the sloughs or creeks (creekbeds). So we'd just build a big campfire and leave it. Maybe couple weeks later even, when the grass is really dry, the grasses would all get burned up, but the fire wouldn't go anywhere because it was still damp in the bush.

Trapline fires left meandering lines of smokes as individual trappers fired streamside grasses on their way out to the larger streams and rivers, where trails joined. An Oblate priest in the Fort Vermilion area described seeing trappers' fires in the 1930's.

> From (Fort Vermilion) you could see the slopes of the Caribous (Caribou Mountains) and you could see the smokes, a string of fires, that the Indian trappers were setting as they came in the spring. You knew they were on their way home then. It was a grand sight!

An elderly Slavey from Meander River Reserve mentioned the trapper pattern of burning and the results of fire exclusion practices.

> Trappers burned when they were on their way home from spring hunting. At that time of year it was safe and they burned because it made it better for them in the winter with more animals to hunt and trap for. Nowadays you can't burn on the trapline because it's against the law, and it's not so good as before.

The regular firing of trapline corridors and yards was recognized as an integral, necessary feature of a hunting-trapping strategy. As has been shown for hunter-gatherers elsewhere in the world, the Indians of northern Alberta understood, and many still understand, the complex networks of plant-herbivore-predator relationships. The comments by informants often reflected the broader understandings about the connections between fire, plants, animals, and human practices. The following statements by older Slavey Indians in the Hay Lakes-Meander River areas concern the systematic relationships between grasslands and forests.

> We made fire there by small creeks. All the grass burns. Then its good for the beaver. New white poplar would come out and the beavers like to eat that.

> A burn attracts all kinds of animals, especially the moose. In three years time the trees grow really fast and the moose like that too. If you burn in spring, the moose will be there in fall. When they burned, the people say, "I will hunt there." And they argue about it because they all know it will be good hunting.

> I did that burning by my trapline where the grass is growing. It's good for fox and lynx. They like eating rabbits and mice and they are in grassy places.

> Lots of animals that live in the forest come to the meadows and sloughs to hunt. Marten, like, they live in the woods but they hunt lots in the grassy places—specially mice. So you don't want to burn the woods, just the sloughs and meadows. Now, course, we don't burn any of it.

> Burning sloughs was also good for foxes. When you get thick grass all bent over it's hard for the fox to dig down to get the mice, and the foxes are really hungry that time of year (spring). When you burn it off, well sure you kill lots of mice—maybe hundreds; you can hear them in the fire but they come back by the thousands. Then it's easy for the fox to get the mice and we get lots of foxes too.

> Do you know that wolves hunt mice? I saw this one (wolf). Real funny. He was jump'n up and down, crazy like. He was catch'n mice. It was so funny I forgot to shoot'm. I laughed so loud he saw me and run away. He was catch'n mice along a creek we'd burned that year.

Their concern for maintaining traplines as corridors was also expressed in terms of problems frequently associated with summer fires, usually started by lighting. Natural fires could seriously disrupt trapline work.

> Summer fires are really dangerous. There was a big one started over in B.C. and burned right through those blue hills. It ruined some places on my dad's trapline. There were lots of deer and moose after that. Those (kinds of) places are good for hunting, just like where he says you burn along your trapline, only sometimes they are really big and there are some kinds of animals (i.e., the prime fur-bearing species) that you don't see there 'til it grows back trees.

Within the surrounding boreal forest and areas of muskeg, small opening were maintained, in some cases "created." Sites were selected on the basis of existing vegetation, an indication of appropriate soils for the growth of desired grasses and shrubs.

> You could make a little grassy area some places in the muskeg. When you were on trapline in the winter you go (back) there and look for moose, cause they find those places and they like'm. It gotta be the right kind of place or the grass and brushes don't grow. The little white mosses grow there.

The apparent casualness with which people approached spring burning belied their understanding of how fires are controlled.

> We didn't watch over the fire. Every time (in the spring) we came to a prairie in the bush, we made a fire there.

The only sections of forest intentionally burned were deadfall or windfall areas. These all but impenetrable areas were fired for essentially two reasons: they are devoid of game (except for some game birds which are all but impossible to shoot or retrieve), and they pose a serious danger to surrounding live forest if ignited by late summer lightning storms. As with meadows, these could be burned under safer conditions in the spring and well before the onset of more dangerous burning conditions. If the plant-soil associations were appropriate, these areas might be maintained as additional yarding areas through repeated spring burning.

> When you burn the deadfall places it burns for a long time, not like the meadows—they burn out fast. Because there's all those dead trees. Maybe the next year you come back, burn it some more and then pretty soon it's all open and the moose really like those places.

In addition to the maintenance of traplines, fire was used to keep trails open. A former employee of the Alberta Forest Service described his observations of Indians burning along trails during the late 1920's.

> I realized that those (trailside) fires weren't going to go anywhere. They (the Indians) only did it in the spring and the fire burned to the wetter stuff and went out... and that's the way they kept trails open through the muskeg areas.

Indian informants described similar examples of maintaining trails.

> On a trail you set a fire and the following year, when you return to the same trail and there's new growth, that's where all the moose are. As I burned there in the fall, I would return in the spring—maybe five moose.

> We used to make fire where there is too much brush to walk easily. After we burn, we could walk. Then, in fall time, we would go there to hunt moose.

Finally, marshes and lakeshores were fired to maintain them in stages of productive new growth as the preferred habitats of muskrats and water fowl, all important as a source of protein, and the muskrat having an added attraction as a prime source of furs. Burning was carried out before nesting began.

> We always burned just before all of the snow melted, before the ducks had started to nest. But we didn't burn after the ducks had nested; we knew when to burn and when not to burn. The spring fires made things good for the ducks, and it was good for all kinds of other animals too.

> A lot of the burning was around the lakes, especially to make it better for the ducks. The ducks like the fresh roots that come in after a fire. They get, like, little potato-things, real sweet, that they like to eat. There's still lots of ducks around, but not like they were before. There was lots more of them then.

> Muskrats like to eat the grass roots, like the reeds that grow round a lake or pond. When you burn them the roots grow more and it makes it good for the muskrats. If it don't burn regular then it don't grow—it gets all choked up, dead stuff—and not so many muskrats.

CONCLUSION

At the time of contact, the overall mosaic of fire in northernmost Alberta would have included a combination of natural and man-made patterns. The pattern deriving from natural fires would have included large to very large "patches" of varyingly aged forests which were primarily the consequence of lightning fires.[10]

[10]In the past, given the combination of natural and man-made fires and the overall reduction of fuels, it is probably the case that fires were somewhat smaller, more frequent, and consequently less intense. Older Indian informants have maintained that, largely because of fire exclusion practices and the build-up of fuel levels, fires (natural or man-made) are now much larger and more dangerous than they were in the past.

In the same areas, the Indian patterns of burning fire yards ("hay meadows" and small forest openings) and fire corridors (traplines, trails, streams, and lakesides) would have existed, standing out in contrast to the pattern of natural fire mosaics. The closest thing to the natural patterning of fires was the Indian practice of burning windfall forests, but similar only in that it involved relatively large areas of forest.

At the same time, the combined natural and man-made boreal forest mosaics of Alberta were different from the more pronounced man-made mosaics described for temperate zones (Day, 1953; Lewis, 1973; Stewart, 1955a,b). It is most like the patterns of hunter-gatherer burning characteristic of the temperate rainforest zones of the Pacific Northwest (Lewis, 1973; Norton, 1979) and Australia (Blainey, 1976; Hallam, 1975, 1985; Jackson, 1968; Jones, 1969).

Our dicussion of the pattern of yards and corridors has been at the most general level without reference to the variability that would occur within such a pattern. The major spatial and temporal dimensions of variability would involve such factors as climate, fire, vegetation history, and even economic and socio-political factors. Given the regional variation within the Canadian boreal forest zone as a whole, the specific patterns of burning may well have varied from one boreal forest subtype to another.

In this respect, the research that has been carried out in northwestern Alberta represents something of a "type site" for how fires have been used in the western boreal forest region. Unfortunately, little research has been done to document the native use of prescribed burning elsewhere in the boreal forest and historic references are sketchy and difficult to evaluate. References for the more northern boreal forest support the concept of a yard-and-corridor pattern of burning (Camsell & Malcolm, 1919, p. 49; Michea, 1960, p. 60), but these do not provide the detailed regional information necessary for detailed comparison.

However, on the larger scale at which the pattern has been looked at here, the employment of functionally parallel solutions to similar problems in biologically different and geographically distant settings appears to represent a significant techno-ecological development by that category of people we classify as hunter-gatherers. In an earlier study (Lewis, 1982a), parallels in the ways that hunter-gatherers managed and manipulated the seasonality, frequency, intensity, and selectivity of habitat fires were singled out from comparing North American Indians and Australian Aborigines. The conclusions that we have made here demonstrate additional parallels in the human technology of fire, what Julian Steward would have seen as examples of "multilinear evolution." That such cross-cultural parallels should exist, however, is perhaps less surprising than how long it has taken anthropologists to recognize them.

Though there are similarities in the patterns of burning boreal forests and the areas described earlier, there are also some important distinctions in the ways that northern Indians came to terms with and manipulated subarctic forests. Among the more important differences between the boreal forest region of northwestern Alberta and those of northwest California, western Washington, Tasmania, a coastal portion of New South Wales, and the southwestern part of Western Australia is the fact that northern forests, unlike temperate rainforests, are subjected to a much greater impact from natural fires. Rowe (1970, p. 245) states that "Fire is an integral feature of the northern forest environment...(and) the widely distributed boreal broad leaf trees and conifers are well adapted to it." More recently, Wein and MacLean (1983) have noted:

> In the North, where there are still large uninhabited landscapes, lightning tends to ignite a greater proportion of fires than in more densely inhabited temperate regions. Lightning-ignited fires in remote areas under very dry conditions may quickly reach a large size, and suppression techniques are generally not effective, even if equipment and personnel are available (p. 10).

As has been noted, the boreal forests of Alberta are similar to the rainforest areas of temperate regions in that primary production rates are relatively low. However, the distinctive pattern of natural fires in the boreal forests and the corresponding adaptations of plants have meant that the indigenous peoples of the Canadian north have had to develop a somewhat different strategy from that which has been shown for hunter-gatherers in temperate rainforest areas. As a technique for attracting relatively scarce game to fire-maintained areas, the employment of yards and corridors *alongside* the pattern of a natural fire mosaic has been an important feature of hunting-gathering-trapping technologies in the Canadian north. Except for the practices of burning areas of windfall forest, Indian fires would have had relatively little effect on forested areas other than to limit the encroachment of trees into grasslands.

Our view is that the distribution and frequency of natural fires would have provided both advantages and disadvantages: advantages in terms of a regular recycling (perhaps every 80–90 years[11]) of northern forests, but generally disadvantageous in terms of the unpredictability, intensity, and extent of lightning-caused fires. Because of the essentially closed cover of boreal forests, understory burning (such as that carried out in the ponderosa pine forests of California or the interior portions of southeast British Columbia) was not possible. Consequently, an overall man-made mosaic was precluded

[11]Ongoing studies in Wood Buffalo National Park in Alberta show that fire frequencies in an area near Fort Smith have ranged from one fire every 35–55 years (Fire Science Center, 1985, p. 11).

except in areas of windfall forest. Thus, the utilization and maintenance of yards and corridors was an effective compromise in burning those areas (meadows, streamsides, sloughs, swales, lakeshores, and trails) which could be managed within an overall region which, with a hunting-gathering technology, could not be fire managed.

While appreciating the fact that the role of fire in such a range of geographical settings is infinitely more complex than we can discuss here, our argument does show important cross-cultural and intergeographical parallels in the ways that hunter-gatherers use habitat fires. The use of fire to maintain corridors and yards in regions of low primary production is clearly a feature shared by hunter-gatherers in distinct regions and different parts of the world. This is similar to what was earlier shown for parallel patterns in the ways that hunter-gatherers use such factors as the seasonality, frequency, selectivity, and intensity of fires (Lewis, 1982a). At the same time, the Indians of northern Canada have also adapted the burning of fire corridors and fire yards to an environment in which fire is an integral factor.

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