

Ethnoecology of the Grand Canyon: Indigenous management past, present and future

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The Colorado Plateau is referred to as a hotspot of biological diversity, but its remarkable cultural diversity is less frequently mentioned (Nabhan et al. 2002). The Nuwuvi (Southern Paiute), Hualapai, Havasupai, Hopi, Zuni, and Navajo tribes all make use of the area around the Grand Canyon for subsistence and cultural purposes. Traditional gatherers from these tribes are aware that the desert and dry forests are full of resources including food, materials and medicines. Tribal management regimes to maintain these diverse resources, including prescribed burning, have led to notable ecological effects. Today, Tribal communities manage around 30% of the Colorado Plateau and participate in conservation planning efforts for public lands, including the Grand Canyon National Park (Nabhan et al. 2002). This paper explores Native American land use on the Colorado Plateau, the scholarly debate regarding the impact of traditional land management, and the current status of Tribal participation in the Glen Canyon Dam Adaptive Management Program.

The peoples of the Grand Canyon and their land

The Colorado Plateau has been occupied by Native American tribes going back to at least 11,500-9,500 BCE (Altschul and Fairley 1989). Today, it is home to 24 tribes and bands representing 6 language families. More speakers of Native American languages live there than in any other region of the United States (Nabhan et al. 2002). The Grand Canyon itself is particularly important in the culture of several tribes; some consider it their ancestral creation site (Dongoske et al. 2010). These tribes, the Nuwuvi (Southern Paiute), Hualapai, Havasupai, Hopi, Zuni and Navajo, still maintain strong ties to this landscape.

To Tribal gatherers from these communities, the Grand Canyon and surrounding uplands provide many resources. Food plants include cactus shoots and fruits, pinyon pine nuts, mesquite beans, agave and yucca stalks, acorns, and seeds from various herbs and grasses (Spoon et al. 2015). In addition, basketry materials used include willow, cottonwood, mountain mahogany, sourberry, yucca, milkweed and cat's claw acacia (Elmore 1944).

However, Tribal gatherers traditionally didn't simply rely on the spontaneous bounty of this biodiverse landscape: they also actively promoted the abundance and quality of the resources. For example, basketry materials are not typically found in the right condition without management. Individual plants, plant patches, or larger areas were treated with prescribed fire to stimulate young, straight growth from resprouting species like willows and sourberry (Bohrer 1983). Fire was also used to enhance wild seed production by promoting open habitat favorable to herbaceous species (Condie and Raish 2002).

Pinyon pines are another important plant to many tribes that requires active management for optimal yields. In addition to providing edible nuts, the needles of this tree are used to make a medicinal tea and its sap is used for waterproofing baskets or for making glue. Pinyon nut gatherers stress the importance of pruning lower branches, removing and burning mistletoe (smoke also reduces mistletoe infestations), and burning downed wood (Spoon et al. 2015).

Besides enhancing plant resources, fire also aids in hunting (either directly by flushing prey or indirectly by promoting fresh growth favored by game species), helps with ease of travel, and reduces the risk of catastrophic wildfires. It should also be noted that fire provides Native Americans with other “eco-cultural services”, including fostering a sense of place, preserving important viewsheds, and maintaining a connection to ancestral practices (Welch 2012, Lake and Long 2014).

This active management runs counter to the view of Native Americans as passive beneficiaries of nature’s bounty, but has become a focus of research in the wake of recent cultural revitalization efforts (Stewart et al. 2002). Nevertheless, this history of land management has typically been ignored by non-Native scientists and land managers. Furthermore, the impacts of colonization, including removal, erosion of traditional knowledge, and forced assimilation have led to a decline in such practices. As a result, conservation planning in the Southwest rarely considers the role of Tribal land management, with negative consequences to such projects as well as to Tribal communities (Nabhan et al. 2002).

Reconstructing Indigenous fire regimes

Recently, there has been a growing interest in historical fire regimes of the Grand Canyon area (and across the West). Changes to dry forests, especially ponderosa pine-dominated forests, have been observed after last century of fire suppression. These changes include a build-up of fuels, an increase in shade-tolerant species such as *Abies concolor*, and a decline in fire-tolerant pines (White and Vankat 1993). This has led to increasing efforts to restore historical fire regimes and to understand the range of variability in fire regimes pre-fire suppression (Grand Canyon National Park 2012).

Understanding historical fire regimes requires not only investigating “natural” ignitions such as lightning, but also the prevalence and effects of Indigenous ignitions. However, the role of Indigenous burning is generally downplayed. Studies aiming at reconstructing past burning patterns do not frequently go beyond merely mentioning the Native inhabitants of the area and their use of prescribed fire (Wolf and Mast 1998, Fule et al. 2000). It is often assumed that the cultures of the Colorado Plateau did not depend heavily on wild plants due to their cultivation of corn, although this reliance may be grossly exaggerated (Sullivan and Forste 2014). In addition, the importance of anthropogenic ignitions is dismissed because the very high frequency of storms and lightning ignitions on the Colorado Plateau (Allen 2002, Fulé et al. 2003). In an environment where fire regimes are limited by fuel build-up and not by ignition rates, it is

assumed that additional ignitions by Native peoples do not mark a departure from the “natural” range of variability (Swetnam and Baisan 1996, Swetnam et al. 1999).

Researchers skeptical about a significant role of Indigenous burning typically rely on fire-scar records (Swetnam and Baisan 1996, Fule et al. 2000, Allen 2002). Yet this method is problematic because very few trees still exist that can offer insight into fire regimes pre-1700 (Sullivan et al. 2015). Nevertheless, the record shows that in parts of the inaccessible North Rim where fire suppression efforts are non-existent, fire return intervals doubled following the removal of Native Americans (Fulé et al. 2003). In the Sacramento and Chiricahua Mountains, fire-scar data reveal that areas frequently used by the Apache burned more frequently and in a different season (winter and spring) compared to more distant areas, suggesting intentional manipulation of the fire regime (Seklecki et al. 1996, Kaye and Swetnam 1999). And even if the broader landscape was not vastly altered by Indigenous management, the influence of Native peoples on the fire regime in some places and some periods cannot be doubted. For example, isolated areas that saw very few lightning ignitions in the twentieth century nevertheless burned at high frequency pre-settlement (Swetnam and Baisan 1996).

In contrast to fire-scar-based methods, pollen records, soil charcoal and phosphorus content, and carbon isotope data can yield valuable information about much older periods. These methods also yield information on the relative abundance of herbaceous and woody species. Another major benefit is that these methods can be used in pinyon-juniper habitats, which, unlike ponderosa pines, do not record fire-scars (Roos et al. 2009). These methods have indicated that late prehistoric inhabitants of the Grand Canyon area widely used fire to promote herbaceous species, and that these patterns of burning do not match fire frequency predictions based on reconstructions of the climate. The effect of burning is particularly evident using these methods near the Grand Canyon in 850-1200 CE, and on the Mogollon Rim around 1200-1400 CE and again around 1600-1870 CE (Roos et al. 2009). According to this research, Native American burning fundamentally altered the ecological conditions and economic potential of pinyon-juniper woodlands and ponderosa pine forests, although the effects were variable through time and across ecosystems (Sullivan et al. 2015).

The intentional use of fire as a management tool by Native American tribes in the Southwest is widely accepted (Condie and Raish 2002), even though the consequences and scale are still debated. But regardless of the scholarly uncertainty, Tribal cultures continue to emphasize the importance of physical and spiritual involvement in the landscape (Long et al. 2003). This includes fuels reduction in piñon-juniper forests, patch burning in sagebrush habitats, clearing springs, and songs and prayers intended to ensure an ecological and spiritual balance. Failing such obligations, it is believed that the health and productivity of the landscape will be jeopardized (Spoon et al. 2015). This ethic of caring for the land extends beyond the management of economically-important plants to a concern for the health of all ecosystems throughout Tribal homelands (Long et al. 2003).

Co-management in the Grand Canyon

The long-standing Indigenous traditions of natural resource management demonstrate the stake of Tribal communities in the continuing stewardship of the Grand Canyon and surrounding area. Today, many Tribal members maintain a close relationship with sites within the Grand Canyon area, both on and off reservations (Stoffle et al. 1997, Jackson-Kelly et al. 2013). The federal trust relationship requires that management of natural resources under federal jurisdiction must be done in consultation with tribes (Donoghue et al. 2010).

One example of Tribal involvement in conservation in the Grand Canyon is the participation of several tribes in the Glen Canyon Dam Adaptive Management Program (GCDAMP): the Hualapai Tribe, Navajo Nation, Hopi Tribe, Pueblo of Zuni, and Kaibab Band of Paiute Indians and Paiute Indian Tribe of Utah (Shivwits Band), represented as the Southern Paiute Consortium (Dongoske et al. 2010). Tribal values are officially considered as part of the purpose of the GCDAMP. Of the 12 goals of the program, goal 11 is “the management of cultural resources for the inspiration and benefit of past, present, and future generations”. Goal 12 further requires “meaningful tribal participation” in the program to make sure that Tribal values are incorporated into the scientific activities of the GCDAMP. Under this program, significant advances have been made, including educating non-Native stakeholders about Tribal culture and concerns, implementing cultural site monitoring by tribal youth, and intergenerational knowledge sharing (Austin et al. 2007).

However, the process has been criticized by Tribal representatives as promoting “the disenfranchisement of participating tribes” and “the continuation of colonialist attitudes” (Dongoske et al. 2010). Reasons for this failure stem from a lack of understanding of Tribal culture, including the assumption that Tribal perspectives could be integrated into a quantitative framework based on Western science (Austin et al. 2007). Since the inception of the GCDAMP, these problems have caused Tribal participation to decline, and Tribal input is currently minimal (Dongoske et al. 2010). Specifically, Tribal participants have felt marginalized due to: the requirement to use scientific vocabulary and concepts to express themselves; a perception of condescension and intimidation from non-Native participants when failing to use such language; the confrontational style of debates, which is antithetical to Tribal culture; and the lack of response by managers to Tribal concerns (Dongoske et al. 2010).

For example, when managers proposed an experiment to mechanically remove invasive trout from the confluence of the Little Colorado River, Tribal representatives pointed out that this is a sacred site, and that Tribal cultures prohibit killing within such places. The response of managers was to offer to provide the fish remains to the tribes as fertilizer for their gardens. No effort was made to find an alternate method or site for this experiment. The trout removal continues to this day despite objections from Tribal representatives (Dongoske et al. 2010).

Furthermore, Tribal concerns remain low priorities for scientific inquiries by the GCDAMP. The focus continues to be on biological resources, especially species that

are endangered, invasive, or of recreational significance. In contrast, little attention has been paid to the impact of current management on cultural sites, including archaeological sites, culturally significant plant communities and other cultural resources. Erosion of ancient river terraces supporting such sites has not been investigated intensively, despite the suggestion that sediment depletion may be contributing to the threat facing such sites. As a result, the effect of post-dam hydrology or of recent high-flow experiments on cultural sites remains largely unknown and unaddressed (Pederson et al. 2006, Pederson and O'Brien 2014). Since biological and cultural resources are linked in Tribal cultures, the overwhelming focus on species-level management to the detriment of cultural sites is a source of frustration and marginalization for Tribal participants in the GCDAMP (Dongoske et al. 2010).

Overall, these problems stem from the tendency of non-Native scientists and managers to dismiss the relevance or accuracy of traditional knowledge, and even the very concept that Native peoples intimately understand and have managed their landscapes for hundreds or thousands of years. Solutions to meaningful participation include developing a stronger social science component to the planning process, cultural sensitivity training for participants, and a greater effort to focus on the overlap between the scientific, management and traditional paradigms (Dongoske et al. 2010). Despite good intentions, the GCDAMP is unlikely to effectively represent Tribal participation without major overhaul (Austin et al. 2007).

Conclusions

Traditional gatherers from Tribal communities of the Colorado Plateau continue to collect plant resources from riparian, desert, and conifer ecosystems surrounding the Grand Canyon. They collect sourberry sticks and yucca leaves for baskets, cactus fruits and pinyon nuts for food, and numerous other species for teas, medicines, dyes, and ceremonial purposes. As is the case around the world, these tribes developed methods to enhance the quantity and quality of the species they relied on, particularly through the use of fire. This stewardship ethic is part of the reasons that tribes continue to engage in conservation efforts to protect their biological and cultural heritage. However, a lack of awareness of Tribal values and practices, and a reluctance to consider Tribal input that is not couched in the language of western science have led to largely ineffective participation in regional management plans such as the GCDAMP.

Conservationists and managers have mostly failed to link the Grand Canyon's twin status as a hotspot of biological and cultural diversity (Nabhan et al. 2002). Yet the tribes continue to uphold their felt responsibility to look after the lands, water, and natural resources of their homelands for the sake of past, present and future generations. Besides its relevance to fire and plant communities, Tribal traditional knowledge can enhance conservation and preservation efforts in the National Park. For example, Tribal knowledge was instrumental in the reintroduction of California condors to the Grand Canyon (Nabhan and Martinez 2012), while Zuni-style checkdams are built to combat erosion around sensitive sites (Riper and Mattson 2005). It is no coincidence that the Colorado Plateau is both biologically and culturally diverse. Rather, these two forms of diversity have been intertwined for millennia. Improving collaborative efforts

between agencies, researchers and tribes must therefore be a priority to ensure effective and fair management outcomes.

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