

The Mitigation of Forest Fragmentation: Toward a New Ecology of Blended-Landscape Communities



James G Cantrill*

Department of Communication & Media Studies, Northern Michigan University, USA

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***Corresponding author:** James G Cantrill, Department of Communication & Media Studies, Northern Michigan University, USA

Abstract

Among other forces, recent population increases have hastened urban and rural sprawl into undeveloped, typically forested spaces resulting in what could be characterized as blended-landscape communities wherein people, fish, and wildlife depend upon a pool of shared ecosystem services. In turn, a cascade of human induced changes heralded substantial deforestation, wildland fragmentation, and the creation of biotic archipelagos fostering loss of biodiversity and human-nonhuman conflicts over valued resources. It has become a problem of global proportions often responded to by regulatory and rhetorical attempts to preserve habitat, the effectiveness of either approach pivoting on understanding and accounting for why people value forested landscapes in the first place. This review article reframes existing scholarship regarding place meaning and placemaking, perceptions of forested environments, and drivers of forest fragmentation with an eye toward identifying adaptive landscape-scale strategies designed to preserve biodiversity. It is argued that efforts to enhance ecological literacy via educational or regulatory campaigns in already fragmented forested-areas may be shortsighted considering a distinctly social milieu in the relative darkness beyond the edge of town.

Keywords: Forest fragmentation; Place perception; Communication; Mitigation strategies; Habitat loss; Biodiversity; Resource conservation; Blended landscapes; Wildlife resources; Environment

Introduction

Population growth on Earth over the past two centuries has left a significant mark on fish and wildlife populations, especially in forested regions of the planet. Since 1800, as humans expanded from roughly one to seven billion inhabitants, urban areas outstripped the sustainability of adjacent farmlands and other nearby resources, thereby inducing migratory patterns accompanied by transportation infrastructures and a further increase in anthropogenic forest fragmentation [1-3]. Today, approximately 70% of the remaining forest cover lies within 1 km of edge ecotones [4]. In turn, a cascade of human induced changes has resulted in substantial deforestation, wildland fragmentation, and the creation of biotic archipelagos that threaten biodiversity, traditional lifestyles, and human-nonhuman conflicts over valued resources in expanding ecotones across the globe. Furthermore, by the turn of the next century, estimate that half of all tropical forests will be on-edge, adding an additional 500mt of carbon to the atmosphere due to floral mortality [5]. It has become a vexing, wicked problem often mandating regulatory attempts to rein in expansionist development and conservation efforts in the name of restoration ecology [6-7].

Despite substantial efforts, global biodiversity declines apace, largely due to an inability of field biologist and resource managers to successfully influence behavior and policy at the local level [8-9]. A “seemingly intractable human dimension at the intersection of social, economic, and ecological forces complicates the efforts of conservation professionals to the extent that we must discover new ways to address age-old problems of carrying capacity, habitat loss, and the like” [10; p.73]. The time has come for resource managers to employ novel approaches for protecting ecosystem services from the ravages of forest fragmentation.

In the following article, I begin by briefly reviewing the nature and drivers of forest fragmentation, in general, since these factors ultimately provide clues for adaptive management on what forested landscapes remain on Earth. In doing so, I move away from traditional biological analyses of habitat loss to explore forest fragmentation from the vantage of psychological and sociological studies of “place.” In particular, I use data from place-based research in the United States to reframe existing scholarship regarding perceptions of forested environments in the context of the forest fragmentation dynamic. I conclude with suggestions

regarding how we might best promulgate attitudes and policies aimed at preserving remnant biodiversity while, at the same time, enhancing the livelihoods of those who relocate within forested regions.

Forest Fragmentation, Habitat Loss, and the Social Milieu

Among the sundry threats to global ecosystem vitality and biodiversity [11], contractions in landscape-scale forests contribute the greatest percentage of human induced risks. Although different causes and types of forest fragmentation are possible [12], all result in habitat degradation and the production of edge ecotones that hasten trophic cascades of invasive species, disease, and genetic discontinuities [13]. The pattern of landscape-level change is most pronounced in tropical regions, though akin to what is found in the temperate forests of the more developed North: Transportation infrastructure aimed at fiber production or agricultural conversion leads to forest fragmentation resembling the classic “fishbone” pattern of clearings [14], ecological degradation, and eventually regeneration or preservation of island patches with less biodiversity and basal mass [15]. Paradoxically, some wildlife species in fragmented landscapes may be more resilient to the effects of climate change than those in contiguous forests [16], but the net loss in overall biodiversity and other resources needed for human survival is staggering in its implications for sustainability.

A variety of studies [17-19] demonstrate how changes in the amount of forest cover in the tropics, the local combination of modified vs. “natural” patches of habitat, and the distribution of development over a landscape interact in both positive and negative ways for individuals that inhabit forested areas. Clearly, access to harvestable resources can provide economic benefits to impoverished populations, especially if a transition to a more sustainable economy is achieved once those original riches are exhausted. Depending on community size, there can also be a boon in trade and health or education services, as long as there is the political will and wherewithal to support migrant populations (as is sometimes the case in the developed North). Ironically, however, as fragmentation begets denser community development and greater economic abundance, more remote landscapes face increased developmental pressures [20]. In time and without regulatory mitigation, local effects of trophic cascades on biodiversity and forest cover can have far-reaching implications for the livelihoods of those far removed from rapaciously transforming forested landscapes. For example, deforestation and the migration of settlers into the Amazon basin has adversely affected the continental “flying river” that brings moisture to southern Brazil and is now considered one of the principal causes for periodic droughts affecting the São Paulo region [21].

The hydraulics of forest fragmentation in the developed North and developing South begin at the structural level of economic

conditions, governmental policy, and the interface between technological and cultural evolution [22]. In turn, varying patterns of deforestation and the rise of settlements depend on the localized effects of available resources such as water and soil chemistry, existing transportation corridors left over from previous resource extraction regimes and energy infrastructure opportunities, and generational perceptions of valued lifestyles. For example, in the United States after the close of the “American frontier” [23], the availability of affordable land with access to arable regions or extractive resources and federal policies directed at populating the hinterlands gave way to late-20th Century desires to leave crowded cityscapes for more pastoral settings [24- 26]. Such generally resulted in the development of “rural sprawl” surrounding what Cantrill and associates (1999) characterized as “compact” urban areas providing service-hubs for residents living in the forest. This model of development, especially under state-driven conservation regimes aimed at maintaining large tracts of sustainably exploitable landscapes, results in lesser degrees of forest fragmentation. In contrast, for the developing South, economic conditions and lack of government regulation controlling migration into marginally accessible forested areas has resulted in more extensive fragmentation and habitat loss [27-28]. An important distinction to draw [29] suggests it is not tangible or intangible forest resources per se that compel individuals to conserve forests, fragmented or otherwise. Rather, it is one’s economic throw-power combined with distance from those resources that prompts the conservation impulse. The issue is further complicated by recent findings that new migrants, and especially the young, who lack access to established social structures, seem ill-prepared to deal with and adapt to changes in land cover around colonized territory [30]. In either case, residents in the forests of the South live at the limits of institutional structures which can cultivate, as suggests, cultivate an intense self-reliance and a significant distancing from governmental influence [31].

There may be another approach to encountering the tension between biotic integrity and population expansion out from previously developed landscapes. Instead of viewing the situation beyond the edge of town and in the countryside as a zero-sum tradeoff between humans and non-humans, we can think of this dynamic as involving a variety of blended-landscape communities. For the purposes of this analysis, blended-landscape communities represent habitation (e.g., built or natural habitats, clusters of housing kinship units) of different species at different spatial scales that (a) interact among themselves on a regular basis either ecologically or symbolically (e.g., at market, when discussing wildlife threats), (b) are separated from other groups by ecotonal edges or property lines, (c) have regular interspecies contact at or beyond those edges (e.g., resource conflicts, subsistence hunting), and (d) exist across landscapes dominated by the forested environment. For example, small dispersed farms or mining claims

would be considered blended-landscape communities while largely isolated developments (e.g., merely a woodlot, a lone cabin in the woods) or urbanized areas with only small nearby forested islands and inner-city protected areas would not. In the developed North, such would often be characterized by swaths of recreational in-holdings on public lands while in the South it would typically come in the form of newly developed clearings for agriculture or resource extraction. Central to this perspective is the role of symbolic interaction processes [32] within and among individuals who communicate about their interactions with one another, the boundaries that divide their worlds from those of other species, the conflicts and coexistences that often characterize ecological relationships, and the manner in which landscape changes over time are foregrounded in perception. Such interactions may be in sharp contrast to those that characterize the more extensively built environment of urban and suburban landscapes [33].

Fragmented Forests and the “Places” In Between

For some time, researchers have called for integrating social and physical analysis when considering the sustainability of ecological systems [34-36]. Some [1] have specifically called for called for “new approaches for investigating human-landscape systems in which geomorphic and societal pressures are central” (p. 7), as they would be in the case of blended-landscape communities. But it is not as if nation states or local communities can put a halt to forest fragmentation altogether [37].

“Forest fragmentation is inevitable, in both agricultural and urban landscapes. It is therefore important to understand how to manage landscapes, as opposed to just the fragments themselves, if we are to optimize ecosystem function and resilience. This is increasingly important in the face of mounting global change, which may increase the risk of a sudden ecosystem-wide collapse. (p. 108)”

Nor is it simply a matter of extirpating settlers from degraded areas so as to restore a trackless forest [38], the State to step-up its enforcement game [19]. Rather, the challenge becomes one of discovering ways to encourage sustainable practices within those regions adapted to shifting ecosystem services [39]. In terms of wildlife conservation and restoration practices in particular, this means resource managers must account for more than the traditional metrics of setting target population levels [40]; they must also shift attention from the landscape they see to the places found in the hearts and minds of those who move into blended-landscape communities.

Advances in the social science of resource conservation [41-43,30,44-45] indicate that perception of place is an important mediating factor in conservation planning and advocacy at a landscape-scale. There are many kindred definitions for what constitutes a sense of place and how it functions [46-48], yet there is a general consensus that issues and values associated with spatially- and temporally-organized landscape features (e.g.,

tropical and temperate forests, grasslands, mountain ranges) in specific locations are focal. Such perceptions can provide access to not only what people value in the environment but also may shape the conservation drama playing out in day-to-day interaction [49]. For example, research suggests that the greater one’s attachment to the social structures of an area—which are arguably weaker in blended-landscape communities—environmental concerns revolve around issues of community culture and health-related issues; conversely, resource protection is more strongly correlated with attachments to the forested landscape per se [50]. Indeed, the construct has been applied to a range of situations including the stewardship of gateway communities for protected areas [51], attitudes toward governmental regulation of natural resources [52], and the practice of adaptive management in forest planning [53]. The sense of place construct may thus serve to move the values of resource management beyond professional enclaves and into the consciousness of local citizens who, arguably, must co-operate with expert prescriptions if we are to preserve and protect the unfragmented forests that remain.

Recognizing that existing social structures in the post-colonial North and South are dissimilar in many ways, it may be yet be instructive to consider findings related to a sense of place in the United States within the context of global forest fragmentation and the emergence of blended-landscape communities on the planet. For example, unless it is explicitly prompted by interviewer protocols, nature is sublimated to economic and social features when depicting the homeland environment and evaluating living conditions in areas around a compact urban area once inhabitants have tenure in a blended-landscape community [54]. Furthermore, not unlike the drivers seen in the developing South and somewhat against conventional wisdom, the social and economic milieu of modern life in the United States seems more indicative of migratory urges than does the appeal of the natural [55]. This finding is somewhat dependent on to the extent to which a person focuses on tangible versus intangible features of the environment in the initial decision-making process to migrate at all (e.g., those whose senses of self and place highlight the physical environment report stronger migratory urges when development occurs than those who define self and place in more conceptual ways).

Analysis of interview data collected in a blended-landscape community located within the Yellowstone ecosystem [56] demonstrated that respondents’ sense of place was divided across three major thematic “clusters” dealing with (a) fairly intangible associations linking an individual to the local landscape and/or social structures, (b) various social relations between respondents and others in the region highlighting tangible activities one engages in social networks, or (c) foregrounding how changes or opportunities in the area depended on government policies. A subsidiary analysis [52] indicated residents choose to migrate into an area so as to avoid constraints upon their social and economic activities that, nonetheless, were being threatened by resource

managers attempting to curtail the degradation of ecosystem services. The older a respondent was, the more their comments mirrored the general focus on the governmental regulatory context and the less they valued intrusion by outside civic forces.

Taken as a suite of studies, each of which focused on a blended-landscape community, these findings do not bode well for many existing efforts to stem the tide of forest fragmentation and habitat loss elsewhere. Arguably, most contemporary campaigns to manage the development of blended-landscape communities involve mass-mediated appeals grounded in principles of conservation biology, often bolstered by government regulations designed to protect biodiversity and the ongoing provision of ecosystem services. However, research establishes that the social and economic drivers of in-migration persist after forest colonization, more abstract notions of biodiversity and ecosystem services are usurped by more tangible needs and desires, and residents of blended-landscape communities are motivated to resist government control even to the extent enforcement capacity is outstripped by on-the-ground activities. In short, blended-landscape communities are peopled places where the natural environment is hardly foregrounded except in times when that non-human environment becomes a threat to livelihoods via direct contact or the *raison d'être* for resistance to State intervention. Thus, we need to discover new approaches to managing the dynamic between forest fragmentation and blended-landscape communities.

Toward a New Ecology of Blended-Landscape Communities

At one level, the argument advanced in this paper echoes position that the boundary between forest and development in blended-landscape communities is artificial at best [19]. As humans interact symbolically among themselves and ecologically with species sharing landscapes, the lines between spaces and places blur in the context of landscape-level changes. Some [57] have argued for examining the informal, place-based practices of individuals facing localized threats to ecosystem services, especially during times of instability and change, in an effort to craft effective management practices.

Of all the “practices” people engage at the edge of the forest, communication with adjacent others in blended-landscape communities may be the most important in the socio-psychological formation of place, adaptation to changing environmental conditions, and reactions to external regulatory efforts [58]. As people become enfranchised in blended-landscape communities, ongoing dialogue about landscape processes produce shared historical interpretations that more-or-less shape their perceptions of place [59-60]; places arise in the context of people selecting and enacting discursive frames that “are not so much preformed . . . but performed” in daily conversations (p. 452). Studies of such performances demonstrate the extent to which local populations can and do act to maintain natural systems

[61-62]. Through discourses of place we are likely to see the most salient interplay between emergent cultures in blended-landscape communities, cognition about the landscape upon which they live, and the social drama of place-making [63]. For example, ongoing interactions in blended-landscape communities about wildlife conflicts may be significant in shaping the ways in which senses of place tied to the rhythms of nature morph into the cadence of society. In the developed North, the focus of that dialogue ranges from mere nuisance (e.g., over, say, the hearty appetites of Red Squirrels or Whitetail Deer) to predation from re-emerging top-line carnivores on the landscape [10]; in the developing South, the discourse is rarely as sentimental as fauna destroy crops and predation significantly impacts livestock herds [64]. As with other aspects of adaptive management scenarios, how blended-landscape communities think and communicate about the human-nonhuman interface is important in forging alternative scenarios to forest fragmentation run amok. For instance, in regions of the developing South where migration sometimes involves indigenous communities being forced to find new subsistence resources, that dialogue is likely to be heavily influenced by traditional worldviews and senses of place better suited to the preservation of biodiversity and ecosystem services [65]. Thus, one potent type of activity warranting inspection is the manner in which people maintain or modify their perception of place through everyday interaction as a prelude to engaging more formal, institutional mechanisms of public participation directed at protecting ecosystem services beyond ecotones around the world.

If we assume that interactions in the private sphere both inform as well as induce broader conservation measures, we can equally assume that dialogic tensions related to the meaning of place that intersect in daily discourse could also influence the manner in which place attachment or a sense of place influence forest fragmentation and habitat loss. Clearly, there exist a well-known suite of physical elements that attend the perception of landscapes [66], but the transformation of those characteristics into the gestalt of place-based meanings pivots on what people feature in describing a setting, how they talk about the land, and who they engage in that dialogic process. Those meanings that are consensually shared (albeit tacitly) among people become inducements and rhetorical tropes for conservation advocacy [58,67]. And it is reasonable to assume that in any blended-landscape community some residents are more connected to neighbors near and far and that those residents, by dint of training or tradition, are more in tune with the value of ecosystem services in the surrounding forest. Such, interpersonal networks allow them to serve as gatekeepers of information between the resource managers and other inhabitants [68-69]. Consequently, the sense of place embraced by those gatekeepers, as well as their understandings of other’s perspectives in the region, would be central to any dialogic attempt to influence landscape activities.

Conservation professionals can certainly facilitate discussions aimed at managing wildlife resources, and help stakeholders

to do so in a way that frames the vitality of blended-landscape communities as being dependent on diverse networks of flora and fauna which, in part, define their collective sense of place. For some [70], the success of any the success of any issue-framing attempt depends on “activating chains of association that reinforce a particular construction of events and connect it to basic beliefs and values” as well as “finding resonant linguistic tags and images that, like a weight thrown over the side of a boat, anchor these meanings and prevent them from drifting” (p. 172). For example, public attitudes toward wolf recovery in the United States change as a function of increased predation of livestock and household pets and media accounts of those encounters [71]. The notion of blended-landscape communities suggests that, as with any natural system-and local stakeholders are part of a landscape as much as any other animal-processes of discourse compatible with conservation designs should become more commonplace over time and better able to withstand competing economic or lifestyle pressures but only if conservation professionals can find ways to attach the values of local ecosystem services beyond the forest edge to the social values embedded in blended-landscape communities at various temporal and spatial scales. And that appears to be the challenge at hand [72-73].

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