LOGGING AND FOREST DEGRADATION

The Exceptional Value of Intact Forest Ecosystems

Nature Ecology & Evolution. Volume 2, Pages 599–610 (2018)

https://www.nature.com/articles/s41559-018-0490-x

As the terrestrial human footprint continues to expand, the amount of native forest that is free from significant damaging human activities is in precipitous decline. There is emerging evidence that the remaining intact forest supports an exceptional confluence of globally significant environmental values relative to degraded forests, including imperiled biodiversity, carbon sequestration and storage, water provision, indigenous culture and the maintenance of human health. Here we argue that maintaining and, where possible, restoring the integrity of dwindling intact forests is an urgent priority for current global efforts to halt the ongoing biodiversity crisis, slow rapid climate change and achieve sustainability goals. Retaining the integrity of intact forest ecosystems should be a central component of proactive global and national environmental strategies, alongside current efforts aimed at halting deforestation and promoting reforestation.

—James E. M. Watson, Tom Evans, Oscar Venter, Brooke Williams, Ayesha Tulloch, Claire Stewart, Ian Thompson, Justina C. Ray, Kris Murray, Alvaro Salazar, Clive McAlpine, Peter Potapov, Joe Walston, John G. Robinson, Michael Painter, David Wilkie, Christopher Filardi, William F. Laurance, Richard A. Houghton, Sean Maxwell, Hedley Grantham, Cristián Samper, Stephanie Wang, Lars Laestadius, Rebecca K. Runting, Gustavo A. Silva-Chávez, Jamison Ervin & David Lindenmayer. 2018.

Forest Fragmentation: Causes, Ecological Impacts and Implications for Landscape Management

http://www.maforests.org/Bogaert_et_al_2011_Springer_HEP.pdf

The process of forest fragmentation due to human activities such as logging or conversion of forests into agricultural areas and suburbanization (Forman 1995) has been identified as the most important factor contributing to the decline and loss of species diversity worldwide (Noss and Cooperrider 1994). Forest fragmentation occurs when a large region of forest is broken down, or fragmented, into a collection of smaller patches of forest habitat (Wilcove et al. 1986; Collingham and Huntley 2000; Fahrig 2003). The outcome of fragmentation can be considered as a 'binary landscape' in the sense that the resulting landscape is assumed to be composed of spatially dispersed forest fragments with a non-forest matrix between them (Franklin et al. 2002).

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Do Appalachian Herbaceous Understories Ever Recover from Clearcutting?

http://manoa.hawaii.edu/hpicesu/papers/1992_Do_Appalachian_Herbaceous.pdf

Life history characteristics of many herbaceous understory plants suggest that such species recover slowly from major perturbations such as clear cutting. We examined herbaceous cover and richness in the understories of nine primary ("old-growth") forests in the southern Appalachian Mountains and of nine comparable secondary forests, ranging in age from 45 to 87 years since clear cutting. Neither cover nor richness increased with age in the secondary forests.

—David Cameron Duffy and Albert J. Meier. 1992. Conservation Biology Volume 6,No. 2. June 1992

Effects of Selection cutting on the Abundance and Fertility of Indicator lLchens Lobaria pulmonaria and Lobaria quercizans.

http://voxinteractif.ca/~forestnb/wp-content/uploads/2014/04/Edman-et-al.-2008-J.-Appl.-Ecol.1.pdf

Although selection cutting is probably less harmful to forest ecosystems than clear cutting, its effects on biodiversity remain largely unexplored. We investigated the previously unstudied effects of selection cutting on the abundance and fertility of two dominating species of epiphytic lichens, Lobaria pulmonaria and Lobaria quercizans, in a northern hardwood forest of New Brunswick, Canada.… Our results indicate that selection cutting has a strong impact on the abundance and fertility of these two Lobaria species, and that studies ignoring fertility may underestimate the negative effects of forestry on lichens.

—M. Edman, A.M. Eriksson, and M.A. Villard. 2008. Journal of Applied Ecology 2008; 45(1): 26-33

Impacts of Forest Harvesting on Biological Processes in Northern Forest Soils

https://www.sciencedirect.com/science/article/pii/S0378112799002972

The soil microflora and fauna complement each other in the comminution of litter, mineralization of essential plant nutrients, and conservation of these nutrients within the soil system. Harvesting directly affects these processes through the reduction and redistribution of organic matter, compaction, changes in plant cover, and modi®cation of microclimate, all of which affect the distribution, composition and activity of the soil biological communities.… Although the relationships among floral composition, faunal diversity and sustained soil fertility are not always clear, there are indications that a simplified soil biological system will adversely affect nutrient cycling, tree growth, and forest health.

—V.G. Marshall VG. 2000. Forest Ecology and Management 2000; 133:43-60

Effects of Seven Silvicultural Treatments on Terrestrial Salamanders.

http://fwf.ag.utk.edu/mgray/wfs493/HarpoleandHaas1999.pdf

We compared the relative abundance of terrestrial salamanders before and after application of seven regeneration treatments in a low-elevation, southern Appalachian hardwood forest in southwest Virginia. Treatments included understory removal, group selection, two shelterwoods, leave-tree, clearcut, and a control. Salamander relative abundance was significantly lower after harvest on the group selection (p0.005), shelterwoods (p0.007 and p0.015), leave-tree (p0.001), and clearcut treatments (p0.001). There was no significant difference in relative abundance during the same period on the control (p0.788) or understory removal (p0.862) treatments.

—D.N. Harpole DN and C.A. Haas. 1999. Forest Ecology and Management 1999; 144: 349-356

Proceedings of Below-Cost Sales: A Conference on the Economics of National Forest Timber Sales

Not available online

Perhaps the greatest long-term threat to biological diversity within the national forests comes not from the direct effects of timber harvesting, but from the indirect ones — in particular, from habitat fragmentation. Habitat fragmentation occurs whenever a large expanse of habitat is broken into a number of smaller patches of smaller total area, isolated from each other by a matrix of habitats unlike the original. It is an inevitable consequence of timbering in the…national forests. Forests are bisected by powerline rights-of-way and logging roads; parts of them are clearcut, selectively logged, or converted to pine plantations. All of these activities are part of the fragmentation phenomenon.

In a certain sense, fragmentation amounts to the placing of man-made boundaries around natural ecosystems (Wilcox 1984). Unfortunately, natural ecosystems rarely conform to these boundaries. Restricted to small areas, surrounded by modified environments, fragmented ecosystems can suffer a loss of biological diversity, most noticeably through the extinction of species. This loss of biological diversity can vary from trivial to catastrophic, depending upon the nature of the disturbance and the species involved. The process by which fragmented ecosystems lose species is a complex one, and I shall only touch upon those aspects that are most relevant to the national forests where the below-cost sales are occurring. These aspects include: (1) the creation of small, isolated populations of plants and animals, (2) edge effects, and (3) roads.

Small populations.— While the management plans for many of the below-cost forests focus on the total numbers of rare species, they rarely consider how these individuals will be "packaged" as a result of timber harvesting. In most cases I suspect that the outcome will be smaller, more isolated populations of forest-dwelling and disturbance-sensitive species, as they become increasingly confined to small patches of uncut timber, surrounded by cutover or poorly regenerated land. These small populations are subject to a number of problems which ultimately may lead to their extinction (see Soule 1983). These problems include vulnerability to natural catastrophes, imbalances in the sex ratio or age distribution, and genetic deterioration.

(1). Vulnerability to natural catastrophes. Small populations are less able to withstand the natural catastrophes that periodically befall them. Forest fires, floods, disease epidemics, winter storms, and the like are all rare events in the lifetime of the individual organism. But over time, such events inevitably occur — not once, but many times — and they can easily wipe out a small population.

(2). Imbalances in the sex ratios and age distributions. For species that reproduce sexually, a healthy population must have not only enough individuals, but also the right ratio of males to females, and the right age structure. If there is a shortage of one sex (usually females) or of individuals old enough to reproduce successfully, then the ability of the population to sustain itself is threatened. For example, about 200-300 grizzly bears remain in the Yellowstone ecosystem. This may seem like a reasonably large number, given the low densities at which this species typically occur. But the number of adult females capable of breeding is only about 35; it is this imbalance that makes the whole population especially vulnerable to extirpation.

(3). Genetic deterioration. Small populations can lose much of their genetic variability through inbreeding and population bottlenecks. This variability, in turn, is what allows populations to persist in the face of an ever-changing environment. Inbreeding and bottlenecks can also lead to the establishment of deleterious traits within populations (Ra1ls et al. 1979, Ralls and Ballou 1983, Soule 1980).

Edge effects. — By clearing portions of the land, most logging operations increase the amount of edge habitat. This is widely perceived to be a benefit of timber harvesting, and there is, of course, some truth to this idea. Edges do attract a variety of plant and animal species that would otherwise avoid the forest interior. Moreover, these edge-dwelling species include a number of important game animals, like the white-tailed deer, ruffed grouse, and bobwhite quail. However, there is also a negative side to edges, one which usually goes unnoticed. Edges alter the climate, vegetation, and fauna of the forest in ways that are not beneficial to many of the forest-dependent species.

When an edge is created, hot, dry air moves in from the adjacent open areas, causing fluctuations in temperature and humidity within the forest (see Lovejoy et al. 1984). Plants unable to tolerate such a changing environment perish from the vicinity of the edge. The wind also uproots trees near the edge, creating numerous gaps in the forest canopy. Foresters in the Pacific Northwest use a three-tree-height rule of thumb of measure how far the climatological effects of a surrounding clearcut will penetrate into an old-growth forest (see Harris 1984).

In eastern North America, researchers have found that the edge supports a different assortment of plant species from the forest interior (Ranney 1977, Wales 1972). In very small forest fragments, the seeds of the edge species fall into the interior of the forest, and ultimately may change the species composition of the fragment, as the plants of the interior are replaced by species from the edge (Ranney et aI. 1981).

Forest edges attract other animals besides deer, woodcock, and quail. Among them are a variety of mammals and birds that prey on the eggs and nestlings of forest-dwelling songbirds (Gates and Gysel 1978, Bider 1968). Edges also draw in the brown-headed cowbird, which parasitizes the nests of other birds. The high levels of nest predation and parasitism that forest-dwelling songbirds suffer in fragmented ecosystems is one reason why populations of these birds have declined in many areas (Brittingham and Temple 1983, Wilcove 1985).

The relevance of these findings to the topic of below-cost timber sales is clear: by creating early successional habitats, these timber operations may be damaging the integrity of even the uncut forested land.

Roads. — All of the forest management plans that I have examined call for the construction of more roads. I view this trend with some concern. Roads come as part of a package of disturbances that includes the road itself, noise from the logging trucks, human activity, and the clearing of a central yarding site for loading the logs onto the trucks. All of this results in habitat fragmentation. Roads can also introduce edge habitat into previously unbroken forest and contribute to erosion. For these reasons, roads should be constructed only where necessary, and then replanted when they cease to be of use.

Fragmentation as a threat to wilderness areas and RNAs. — Finally, it must be emphasized that the wilderness areas and RNAS are themselves not immune to the effects of fragmentation. As the land that borders them is logged, or as roads encircle them, they become more isolated. I cannot predict how this isolation will ultimately affect the plants and animals within these protected areas. But I feel confident in saying that it is something we should avoid wherever possible. There is certainly no biological benefit to disrupting the land around such places, and there may be considerable harm.

—David S. Wilcove. 1986. Biological Diversity in the National Forests and Below-cost Timber Sales in Dennis C. LeMaster, Barry R. Flamm, and John C. Hendee, eds. The Wilderness Society, Washington State University, and University of Idaho. 17-19 February 1986. Spokane, Washington.

Conserving the Biodiversity of Massachusetts in a Changing World

http://www.mass.gov/eea/docs/dfg/nhesp/land-protection-and-management/biomap2-summary-report.pdf

"Forest interior habitat—identified in BioMap2 as Forest Core—is widely recognized as critically important for species sensitive to forest fragmentation and is becoming increasingly scarce in highly populated regions of the country like Massachusetts…. Many bird species that breed in Massachusetts are sensitive to forest fragmentation, including Ovenbirds, Scarlet Tanagers, and many woodland warblers. Negative results of fragmentation include edge effects such as nest predation by species associated with development such as skunks, raccoons, and house cats; and nest parasitism by species such as the Brown-headed Cowbird that lay their eggs in the nests of other bird species and reduce their reproductive success. Forest interior habitats also support a wide range of native plants, animals, and ecological processes sensitive to other edge effects such as noise and light pollution from roads and development, invasive species establishment, and alterations to wind, heat, and other climate variables…. Thirty-eight percent of the total Forest Core area remains unprotected; these areas are high priorities for land protection since they provide important habitat for forest interior and other species." (pp. 48-49)

—Henry Woolsey, Andrew Finton, and James DeNormandie. 2010.

Logging

https://globalforestatlas.yale.edu/forest-use-logging/logging

Deforestation from clearcut logging is highly disruptive to biodiversity, whereas the effects of selective logging are less definitive. Due to the removal of seed sources, clearcut logging prevents the natural regrowth of endemic species…. With selective logging, only high-value species are felled for timber, but many smaller trees are damaged in the process. Selective logging also contributes to large scale forest fragmentation, altering forest micro-climates and making forests more vulnerable to fires, as well as affecting plant and animal species composition.

—Global Forest Atlas: