NEW JERSEY HIGHLANDS COALITION

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Carbon, Climate, and Forest Management: Key New Scientific Findings: Intact, Unfragmented, Unmanaged Forests Maximize Carbon Sequestration and Climate Resilience.

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Forests have tremendous capacity to fight climate change by removing and storing carbon (sequestration) from the atmosphere. It now widely agreed that controlling emissions alone will not suffice if we are to stabilize greenhouse gas concentrations. Collectively we must increase and accelerate atmospheric CO2 removal by forests while also sustaining current carbon storage by forests, wetlands, and soils, according to the latest sobering climate reports form the Intergovernmental Panel on Climate Change (IPCC 2018), and the US Global Change Research Program (USGCRP 2018). While it is essential to plant new trees and reforest open lands, this will not be sufficient, nor fast enough to avoid the worst climate change scenarios.

Our best defense is protection and preservation of our existing forests: protection of large, old trees and preservation of intact natural forests. It turns out that large tracts of contiguous (unfragmented) native forests take up carbon most rapidly, and store by far the most carbon, per tree and per acre. Protection means no management involving timber removal, harvesting, thinning, or even partial logging for firewood. These activities drastically reduce both the volume and the rate of carbon sequestration. In New Jersey, protecting contiguous intact forests is extremely important on public and private lands for carbon sequestration, protecting biodiversity and maintaining critical ecosystem services for clean air and water.

The following presents essential key scientific studies in the field of forest stewardship with brief summaries. These are recent, prominent, data-driven investigations from top peer-reviewed scientific journals, society's most reliably accurate and objectively reviewed body of objective scientific knowledge. Each contains references to dozens of additional relevant studies and incorporates their findings. This is where we must turn amidst many conflicting opinions and assertions advanced on websites and blogs, conference presentations, government reports, and even books, which take years to get into print. Peer-review, as required for publication in a scientific journal, is a rigorous process where theories and ideas are thoroughly scrutinized by experts in the field, contrary to other popular outlets advanced by special interest groups or industry.

With respect to climate change and the successful preservation of New Jersey's ecologically valuable forests, the stakes are too high to gamble on the future of our environment, and our precious natural resources.

Article #1. **Proforestation* Mitigates Climate Change and Serves the Greatest Good.** By Moommaw WR, Masino SA, Faison EK. 2019. Intact Forests in the United States: Frontiers in Forests and Global Change. doi: 10.3389/ffgc.2019.00027
**Proforestation: growing existing forest to its full ecological potential, without timber harvesting*

This project quantifies the carbon sequestration capacity of existing intact forests defined as those both protected and free from human intervention including management, thinning, partial logging, fragmentation, and extensive edges. "Proforestation" is the term for such protection of existing intact forests. Proforestation will yield much greater and faster carbon sequestration than afforestation or reforestation. Intact forests are the most carbon-dense, and if allowed to grow to their greatest potential they will contribute orders of magnitude more removal of greenhouse gases than working, managed forests. Moreover, and this is an important point, it turns out that **starting over with young trees after forest harvest will take many decades for an acre to recover its carbon biomass and uptake rates**. We cannot wait for young forests to get established; instead we should protect today's existing intact forests. U.S. forests currently offset 11% of carbon emissions, but this quantity could be greatly increased by protecting existing intact forests.

In this project, scientists from Harvard Forest, Trinity, and Tufts compile and analyze data from across New England, where on average just 3% of forests are protected from logging. Today in the US, 85% of carbon lost from forests is due to forest harvesting and thinning, with only 3% lost to land use conversion and 12% to fire, pests, and wind. In the New England states, typical 75-year old trees now being culled are only 30% of the way to their typical life spans and sizes. This is also true in New Jersey. Clearly any new and young woodlands and trees should be established on unwooded lands, not in patches cleared from existing healthy intact forests.

Article #2. **Degradation and Forgone Removals Increase the Carbon Impact of Intact Forest Loss by 626%.** 2019. Maxwell SL, Evans T, Watson JEC, Morel A, Grantham H, Duncan A, Harris N, Potapov P, Runting RK, Venter O, Wang S, Malhi Y. 2019. Science Advances 5(10), eaax2546
DOI: 10.1126/sciadv.aax2546

This major study reaches similar conclusions from analysis of global tropical forests. When we lose or manage intact forests (those free from anthropogenic influence), this loss greatly exacerbates climate change, because of the removal of carbon-rich timber but also because previous carbon removal services are lost (foregone). If left in place, trees removed or thinned out would have continued to take up carbon well into the future. This article quantifies the consequences not only from full forest clearance but also from selective logging and thinning, and also from forest

fragmentation and edge effects. Using remote sensing data from 2000-2013 for tropical forests of 10 countries, this research found high rates of clearance and degradation.

Most importantly, the major finding is that **by including the effects of partial logging, thinning, and edges, we see that carbon losses to the atmosphere actually increase by 600**%. This analysis is based on actual changes on the ground across the tropics from 2000-2013. Despite differences between tropical and temperate forests, the observed pattern, of steeper carbon losses when we include effects of partial logging and edges, is equally likely in both areas. It is thus critical to protect intact native forests from fragmentation and partial logging or thinning, which accelerate the increase in atmospheric carbon and its consequences.

Article #3. Stephenson NL *et al*. 2014. **Rate of Tree Carbon Accumulation Increases Continuously with Tree Size**. Nature. doi:10.1038/nature12914

Only a few short years ago, we all expected young trees to absorb and store atmospheric carbon faster than older, larger trees. But just as is true at the level of the forest, carbon accumulation increases with maturity at the individual tree level as well. This study with 38 prominent scientists (including forest scientists) analyzed tree data from 400+ trees of tropics, subtropics, and temperate forests, with repeated measures analysis of 673,000 trees. This metanalysis was published in the highly selective and rigorously reviewed journal *Nature.* For all continents and 87% of species, rates of growth and carbon gain increased continuously with tree mass; this was true of 97% of the largest trees. This belies the usual assumption of declining tree growth with size and age.

Article #4. Hudiburg TW, BE Law, WR Moomaw, ME Harmon, JE Stenzel. 2019. **Meeting GHG Reduction Targets Requires Accounting for All Forest Sector Emissions.** Environmental Research Letters 14 (2019) 095005. https:/doi.org/10.1088/1748-9326/ab28bb

It is often asserted that timber harvest is carbon neutral when wood products are the results as that wood stores carbon too. However, this turns out to be an oversimplification. Greenhouse gas accounting assumptions are examined in this new analysis by forest scientists from Idaho and Oregon. If timber is used in furniture and structures, won't that keep carbon out of the atmosphere? Not so, as we now understand from a cradle-to-grave accounting of forest sector emissions, which considers how much carbon returns to the atmosphere from the moment of harvest. This project used one million observations from forest inventory data to find that carbon sink rates are being overestimated for forest products. Results challenge standard assumptions in state and federal reporting, which erroneously exclude some product-related emissions (transport, manufacturing, losses) and greatly overstate the longevity of products. Thus, state estimates of emissions have been underestimated by 25-55%. The article concludes that overall net carbon storage in wood products is 21% less each year than current models indicate.

Article #5. Haddad NM, et al. 2015. **Habitat fragmentation and its lasting impact on Earth's ecosystems**. Sci Adv. doi: 10.1126/sciadv.1500052

70% of the Earth's remaining forests are within 1 KM of the forest's edge, exposing forested areas to the threats of environmental degradation as a result fragmentation and isolation. This large scale 35-year study of the effects of forest fragmentation found that threats connected to fragmentation include reduced biodiversity and compromised ecosystem services. Further, in the long term there is the real potential for extinction of species. Three aspects of fragmentation all have significant negative impacts: proximity to edges, reduced fragment size, and increased isolation reduces animal residency, movement between the fragments, recolonization and abundance of wildlife.

The effects of current fragmentation of forests are persistent into the future, incurring increasing environmental debts. The study warns current trends will expose more forests to the effects of fragmentation in the future. The study provides useful insight for land managers and states the important case for preserving and restoring large intact tracts of forests.

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Please note that full articles can be accessed by googling the doi numbers in the references.