EDITORIAL

Restoring the Atmosphere: Trees as Imperfect Partners

Steven N. Handel

Are trees the answer? The question, of course, is how to limit carbon dioxide in the atmosphere. The current (November 2022) concentration, 419 ppm, keeps rising and translates into an increasing average temperature for our sweltering Earth. Release of carbon dioxide into the air must be slowed and reversed from current levels for us to avoid the worst scenarios of global warming. Worldwide political will seems wanting, even as the understanding of the problem grows. In addition to rising global heat, we get the correlated problems of more wildfires, sea level rise, and species migration away from historic ranges, both on land and in the sea. Each of these parameters challenges our ability to develop successful restoration ecology projects.

Various solutions have been proposed. Massive tree planting around the world has gotten the most interest and support, as trees metabolize carbon dioxide and store carbon in their wood. We encourage the restoration of tree populations in many habitats to serve people as well as wildlife. Increasing urban tree canopies is a worldwide initiative now and has great public support. Perhaps the boldest large-scale tree planting program is Africa's Great Green Wall, stretching across that huge continent below the Sahara's latitude. Those lands are becoming more arid, and the proposed enormous swath of trees aims to stop desertification and offer human communities wood, food, and a new income source. In some areas regenerating woodland even becomes a tourist draw. The biomass of trees is obvious and the storage of carbon in their wood is apparent. Should this be a universal goal of the restoration ecology community? Warnings have now been brought forward and alternative modes of carbon capture may be more appropriate. Before the restoration ecology world scampers to treetops in celebration, caution may be the more pragmatic behavior.

Planting trees is a tactile joy and can be performed by all ages around the world. This builds community support for our science, to be sure, and is an easier ask from the funding community than more subtle restoration actions. If only the planting of a seedling were the end of the story! Just as in plant population biology, the number of seeds and seedlings is quite different from the eventual density of adult plants. Many life history thresholds must be successfully crossed before maturity; a restored tree seedling needs nurturing and long-term management.

These life-support systems are too often lacking. A tree seedling must be protected from drought stress, herbivores, and invasive species competitors. The local human community must support the tree planting initiative, continually. This takes time and other resources away from food production and other community needs. Institutional support must be persistent. These factors depend upon the restoration community having staying power for local projects even as its people power, ambitions, and leadership change. Are local residents available and willing to nurture the saplings? Have the right tree species been planted to secure local support? Are the goals and needs of the local community addressed beyond the existential threat of carbon dioxide concentration above the town?

The forestry industry often encourages fast-growing tree species that may not be most appropriate for local microhabitats and societal needs. The number of trees that can be planted is not congruent with the value of the plantation that may be needed. Finally, monocultures are often planted in these large-scale projects as they are the easiest to organize and manage during the initiation phase. Monocultures are fraught with ecological shortcomings, from their limited support of a wider biodiversity to the higher probability of death by disease. In our warming world, new stands of trees are also targets for increasing wildfires which can incinerate both new plantings and local enthusiasm. The major international organizations that have supported the Great Green Wall, including United Nations and World Bank divisions, are learning fast and improving their actions. But the dream of a tall green forest remains alluring.

Other solutions to pulling carbon from the air are available. Grasslands have now been shown to store enormous concentrations of carbon in the soil, with ranges that overlap with the ability of forests to become carbon reservoirs. Underground storage of carbon may not be visible to the

doi:10.3368/er.41.1.1
Ecological Restoration Vol. 41, No. 1, 2023
ISSN 1522-4740 E-ISSN 1543-4079

wider public, but the ecological reality of this soil carbon pool has been proven. In many habitats the restoration of grasslands is more appropriate than forested lands and can serve the same functional role of decreasing carbon dioxide. Enormous areas across the globe have grasslands as their historic biome driven by local climate, fire frequency, and grazing pressure. Turning parts of these areas into forests has visual appeal but lacks ecological reality.

As the restoration ecology community hears the siren call of "plant trees," we must lash ourselves to the spar of caution. Long-term carbon budgets must be computed. Storing carbon in tree trunks seems obvious but so many of those trees are cut down and burned to support local societal needs. Funding for managing the new plantings may be lacking. The agency of the local government to encourage support for woodlands may also be weak. Finally, the role of forests must be meshed into an ecological design that integrates the various community needs. Planting 1000 trees in an agricultural setting may deny a food source for people even as it decreases carbon dioxide from the air.

There is a carbon dioxide tsunami above us, and it increases each year. That 419 ppm concentration is a nightmare that keeps expanding. No matter how many trees are planted, this will not be a long-term answer as the plants are overwhelmed by the human release of additional carbon dioxide in bulk every year. One study showed that even if historic forests worldwide were all replanted (that is, ignoring the agricultural, infrastructure, and urban space requirements of eight billion people), within 30 years the forests would have reached their biomass maximum even as society keeps releasing more carbon dioxide through its industrial and transportation actions. There are limits to the ecological restoration world to crafting solutions to the growing carbon concentration above us. Grasslands and sometimes trees will help. But the answer to carbon dioxide concentrations and global warming is social, not wrapped in wood.

Recommended Reading

Brancalion, P.H. and K.D. Holl. 2020. Guidance for successful tree planting initiatives. *Journal of Applied Ecology* 57:2349–2361.

Cernansky, R. 2021. Taking root. *Science* 371:666–667.

Di Sacco, A., K.A. Hardwick, D. Blakesley, P.H. Brancalion, E. Breman, L. Cecilio Rebola et al. 2021. Ten golden rules for reforestation to optimize carbon sequestration, biodiversity recovery and livelihood benefits. *Global Change Biology* 27:1328–1348.

Holl, K.D. and P.H. Brancalion. 2020. Tree planting is not a simple solution. *Science* 368:580–581.

Holl, K.D. and P.H. Brancalion. 2022. Which of the plethora of tree-growing projects to support? *One Earth* 5:452–455.

Kerlin, K. 2017. A Climate Change Solution Beneath Our Feet. https://www.ucdavis.edu/news/climate-change-solution-beneath-our-feet.

Leverkus, A.B., S. Thorn, D.B. Lindenmayer and J.G. Pausas. 2022. Tree planting goals must account for wildfires. *Science* 376: 588–589.

Levin, K. 2019. How Effective Is Land At Removing Carbon Pollution? The IPCC Weighs In. https://www.wri.org/insights/how-effective-land-removing-carbon-pollution-ipcc-weighs.

Shukla, P.R., J. Skea, R. Slade, R. van Diemen, E. Haughey, J. Malley et al. (eds). 2019. Technical Summary in: *Climate Change and Land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*. https://www.ipcc.ch/srccl/chapter/technical-summary/.

Source: Bailey, L.H. 1917. *Standard Cyclopedia of Horticulture.* 4:1817 (New York, NY: The MacMillan Company), The Florida Center for Instructional Technology, College of Education, University of South Florida, fcit.usf.edu.