The Canadian Field-Naturalist

Book Reviews

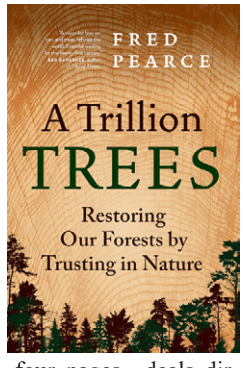
Book Review Editor's Note: *The Canadian Field-Naturalist* is a peer-reviewed scientific journal publishing papers on ecology, behaviour, taxonomy, conservation, and other topics relevant to Canadian natural history. In line with this mandate, we review books with a Canadian connection, including those on any species (native or non-native) that inhabits Canada, as well as books covering topics of global relevance, including climate change, biodiversity, species extinction, habitat loss, evolution, and field research experiences.

Currency Codes: CAD Canadian Dollars, USD United States Dollars, EUR Euros, AUD Australian Dollars, GBP British Pounds.

Conservation and Climate Change

A Trillion Trees: Restoring Our Forests by Trusting in Nature

By Fred Pearce. 2022. Greystone Books. 335 pages, 34.95 CAD, Hardcover.



In *A Trillion Trees: Restoring Our Forests by Trusting in Nature*, Fred Pearce offers a sober but not overly pessimistic response to the much-discussed Crowther-Bastin theory that a global reforestation campaign to plant a trillion trees might significantly correct our planetary carbon crisis (see Crowther *et al.* 2015 and Bastin *et al.* 2019). Yet only a surprisingly short segment—four pages—deals directly with the one trillion tree proposal of the book's title.

A few years ago, there arrived an innovative and promising proposal for the Earth's excess carbon problem, and it was welcomed with wide media coverage. Bronson Griscom of The Nature Conservancy argued that "nature-based solutions" could at least initially absorb up to ~23.6 billion tonnes of carbon dioxide a year and, when combined with emissions elimination, the carbon drawdown solution could be in hand (Griscom *et al.* 2017; The Nature Conservancy 2017). Thomas Crowther *et al.* (2015), together with Jean-Francois Bastin *et al.* (2019), developed a technique to map the existing global forest cover and spaces where trees might potentially grow outside of human settlement and agricultural zones. They calculated there was room for a trillion trees, give or take—enough to absorb 205 gigatonnes of excess carbon, which happens to be in the ballpark of what is warming the Earth (300 gigatonnes have been added since the 1800s; see Crowther *et al.* 2015). If true, and the growth was successful and sustainable, it could quickly solve the carbon problem through biological sequestration—the natural absorption and storage of carbon dioxide by plants and vegetation, including trees. It has been estimated that nature-based solutions could provide 30% of the Paris Agreement temperature goals (see Griscom *et al.* 2017). Canada has a plan to plant two billion trees (Government of Canada 2022).

A primary critique of the trillion tree proposal comes from those who are concerned that carbon offsets might discourage de-industrialization. They argue that focussing the public's attention on tree-planting takes away from the larger issue of reducing fossil fuels. The authors of the original trillion tree proposal issued three corrections to their study (Bastin *et al.* 2019), which included a statement that they were wrong to claim "tree restoration is the most effective solution to climate change to date" (Bastin *et al*. 2020: online). Since then, even Crowther has walked back some of his original arguments (Greenfield 2021).

Pearce makes clear at the start of his book that if we want a trillion more trees on our planet—and he believes we should—a large-scale, global project to plant them is entirely unnecessary. Instead, he argues for a primarily naturalized process of tree regeneration and forest expansion supported by Indigenous foresters and small-scale farmers, progressive urban greening policy, and with strategic attention given to key fast-growing regions of the globe. Human-engineered

planting is not excluded from the book, but Pearce defers to the well-known (to naturalists) process of ecological succession. He travels the globe in search of a variety of reforestation and afforestation methods, successes, and failures, all while retaining some enthusiasm for the possibility that biological sequestration might work.

But the benefits of reforestation vary region to region. Pearce tells us in *A Trillion Trees* that the conifer forests of Siberia and parts of Canada produce five times more global heating than cooling because their transpiration rates are low, unlike in the Amazon tropics. Pearce also explains that the albedo effect of tree cover absorbing sunlight that otherwise would be reflected by snow can mean that planting trees in the north is counterproductive.

Overall, the expansion of forests worldwide seems to be a worthy project. And, by my calculations, with one million expert tree planters from around the world you could (in theory) "replant" the Earth with a trillion trees in one very optimistic year. Professional tree planters can plant 2000–5000 trees a day (Chaplin 2020); one million professionals × 3000 trees per day × 333 days = ~1 trillion trees. With a 75% tree survival rate and using Crowther *et al.*'s (relatively high) cost of 30 cents paid out per tree (Crowther *et al*. 2015), the overall price tag is chump change, in my opinion. Crowther *et al*. estimated it could cost as little as $300 billion. A conservative estimate by Austin *et al.* (2020) was that it would cost $12 trillion over 30 years. Whatever the imprecision of all these numbers, and the glossing over of the many logistical problems, including growing the seedlings, transport into—and housing tree-planters in—remote areas, drone planting limitations, opening of roads, and biodiversity problems, the project seems feasible over a relatively short length of time. Either way, it seems a deal at any price if trees alone could save the planet from anthropogenic carbon abuse and climate disaster.

What might surprise many is that most forests are neither pristine nor original, even the old ones. One estimate is that up to half the Earth's ice-free surface was under cultivation by humans 6000 years ago (p. 96). That surface is now "almost all marked by extensive human occupation and alterations", says Pearce, although the destruction of trees globally "peaked at the end of the twentieth century" (pp. 7–8). Amazonian forests, therefore, are descendants of human-domesticated species. While 16 000 species persist in those tropics, a mere 227 species "hyperdominate" because of cultivation preferences (p. 88). There is evidence for this in Cambodia and Borneo too, and from the Americas to the Congo. This feeds into Pearce's primary hypothesis that given time and space, the Earth's forests and soils will regenerate themselves. Nature is resilient.

Trees can capture carbon, but they can also contribute to global warming. Trees emit oxygen, and water vapour that creates clouds that reflects sunlight, but also volatile organic compounds (VOCs). The latter may—counterintuitively—cause a buildup of methane (Unger 2014). That balancing act and debate regarding trees as carbon sinks or as liabilities continues.

There is some urgency to the tree expansion problem. In one paper authored by 225 researchers, Pearce found data showing that once daytime temperatures reach 32°C, tree growth declines rapidly and carbon emissions quadruple (Sullivan *et al.* 2020). Wildfires are also increasing, transforming some forests into grasslands. Yet fires are also necessary for new growth and for removing underbrush, and human-prescribed fires known as controlled burning are still a good idea because they can reduce the risk of out-of-control fires from thick undergrowth, grass, and dead branches.

The human impacts of poor forest management are hard to miss. That includes the effects of large-scale conversion of rainforests to rubber plantations and for palm oil. Two-thirds of deforestation in the tropics originates from displacement by large-scale commercial agriculture (p. 137). And unfortunately, the rate of destruction has increased by 43% in the five years since the New York Declaration on Forests in 2014 (p. 143).

More than 40% of European Union timber is cut to produce energy from combustion (p. 129). The Drax power station in North Yorkshire, England, produces more carbon dioxide from burning wood pellets than the combined emissions of 124 nations (p. 130). It is difficult to believe that trees grown in Mississippi, dried and processed into pellets, then transported across the Atlantic by ship to the Drax power plant in central England, could be burned efficiently, even if the forests in Mississippi are being expanded to fit that purpose. The trees removed would need to be replaced tree for tree and in a timely way to be carbon neutral, *A Trillion Trees* points out. Converting 10 of Europe's largest coal-burning power plants to biomass-burning would consume the equivalent of an annual 40 million tonnes of wood pellets (equivalent to half of Germany's Black Forest; p. 133). One possibly sensible option is to deploy bioenergy with carbon capture and storage technology (BECCS), which would bury the carbon dioxide that is expelled.

More than 3.5 billion cubic feet (99 million m^3) of timber—10% of the total trade—was logged illegally in the 2010s (p. 123). China is a major culprit and comes in for pointed criticism in the book. Although banning cutting in their own natural forests,

the Chinese have processed timber from elsewhere, including half of the tropical hardwood trade, much of it illegal. This includes "buying okoumé from West Africa, meranti from Borneo, teak from Myanmar, greenheart from Guyana, rosewood from Ghana and merbau from Indonesian New Guinea" (p. 124), with Europe as a major market for these "Chinese" timber products and raw logs. Some progress has been seen as a result of a new 2020 Chinese law cracking down on the contraband trade.

There is some more good news. The extent of deforestation may not be as severe as first thought—much of forest loss has regrowth potential. The ratios also vary, with the greatest amount of 'permanent' forest removal happening in Southeast Asia and Latin America, and the least in North America, Russia, and Africa (p. 153).

Animal species are demonstrably more resilient than some think. While El Salvador saw a loss of its pristine forests to coffee and sugar plantations, only three of its 500 bird species were eliminated, leading Pearce to suggest that "even a limited amount of forest can sustain a vast variety of wildlife" (p. 155). And while we should prioritize intact forests, "degraded" forested areas overall may be restored over time. The debate is over the best way to accomplish that. The second half of *A Trillion Trees* delves into this subject area.

We know that trees can return because Europe's trees have successfully regrown since their lowest point in the 1850s, replacing twice as many as were consumed, although not necessarily with the original species, nor with the desired diversity (p. 172). And, key to the book's primary thesis that tree-planting should not be our focus, there is some effort to allow for natural regeneration through the process of succession. If forests were left to regrow for 60 years, they might capture close to the Intergovernmental Panel on Climate Change (IPCC) target of 200 billion carbon tonnes. Succession success has been observed in Puerto Rico, El Salvador, and even parts of Brazil (p. 203).

But is the pace of recovery fast enough? According to Robin Chazdon (2014), 80% of tree species can be anticipated to return in 20 years, and (possibly) 100% in 50 years. Human planting, such as proposed by Bastin and Crowther, is more expensive and probably less successful. However, where there is an absence of trees in the periphery of zones available to regenerate trees lost, a "founder stand" can be planted to hasten the process. The other advantage of natural regeneration is that ecosystems that have altered due to the impact of clearance or climate change will adapt and develop the most effective restoration sequence, which (again) may not result in the original or even indigenous species dominating, but a more durable replacement. For that reason, it may be necessary to boost rare and endangered species.

Contrary to the theory of the tragedy of the commons, there is a good case to be made (and a Nobel Prize for economics citation) for community-owned forests (as distinct from state-owned and "protected" parks), and there is some evidence of success from Nepal, Mexico, Guatemala, the Democratic Republic of the Congo, Ghana, and the mangrove swamps of Tanzania. An estimated half of the world's forests are likely locally- and community-owned (p. 248). The problem has been cattle ranching to service international clients or, in many cases, ill-managed subsistence farming. Large-scale commercial sawmills with markets in the USA, Europe, and Asia are also doing much of the damage.

Pearce also aims a sharp rebuke at "fortress conservationists" who call for removal of Indigenous Peoples from protected areas, even though Indigenous Peoples can be among the most responsible protectors of the land and forests. While *A Trillion Trees* makes a convincing case for the collective property rights of these populations practicing sustainable forest management, some readers may quibble with occasional pronouncements (pp. 231, 240) about "superior" Indigenous knowledge.

This is a good read and a necessary catch-up reference outlining many of the environmental debates around a very current and urgent topic.

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