# Second Assessment of the Impact of COVID-19 on Forests and Forest Sector in North America

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The sixteenth session of the UN Forum on Forests (UNFF16) in April 2021 requested the Forum secretariat, in collaboration with members of the Forum, CPF member organizations and stakeholders, to conduct an assessment of the challenges faced by countries, and the strategies, recovery measures and best practices for reducing the impact of COVID-19 on forests and forest sector, and to present it to the Forum at its seventeenth session in May 2022. To conduct this second assessment, the UNFF Secretariat commissioned a series of assessments in different regions and subregions.

# Assessment of the Challenges Faced by Canada and the United States of America from COVID-19: Strategies, Recovery Measures and Best Practices for Reducing the Impact on Forests and the Forest Sector

Report prepared for United Nations Forum on Forests Secretariat, DESA

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This document has been prepared by a consultant (John Stanturf, InNovaSilva) based on literature review, interviews with key informants, and own assessments. It does not necessarily reflect the views of UNFF; UNFF does not guarantee the accuracy of the data included in this work.

## Abbreviations and Acronyms

| | |
|---|---|
| ADS | Aerial Detection Survey |
| APHIS | US Animal Plant Health Inspection Service |
| BLM | US Bureau of Land Management |
| CARES | Coronavirus Aid, Relief, and Economic Security Act |
| CDC | Centres for Disease Control |
| CEZD | Canadian Community for Emerging and Zoonotic Disease |
| CFPA | Canadian Forest Products Association |
| COFO | Committee on Forestry |
| CPF | Collaborative Partnership on Forests |
| CRS | Congressional Research Service |
| COVID-19 | Coronavirus Disease 2019 |
| DIY | Do-It-Yourself |
| DOI | United States Department of the Interior |
| ES | Ecosystem Services |
| FAO | Food and Agriculture Organiati0on of the United Nations |
| FPAC | Forest Products Association of Canada |
| FWS | US Fish and Wildlife Service |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |
| GHG | Green House Gas |
| GI | Green Infrastructure |
| IIJA | Infrastructure Investment and Jobs Act |
| ILO | International Labour Organization |
| IPCA | Indigenous Protected and Conserved Area |
| IPCC | Intergovernmental Panel on Climate Change |
| ITAC | Indigenous Tourism Association of Canada |
| ITEK | Indigenous Traditional Ecological Knowlkedge |
| IUCN | International Union for Conservation of Nature |
| NGO | Non-Governmental Organization |
| NIPFL | Non-Industrial Private Forest Landowner |
| NPS | United States National Park Service |
| NRCAN | Natural Resources Canada |
| NWFP | Non-Wood Forest Products |
| OHZDP | One Health Zoonotic Disease Prioritization |
| PPE | Personal Protective Equipment |
| PPP | Paycheck Protection Program |
| SARS-COV 2 | Severe Acute Respiratory Syndrome Coronavirus 2 |
| SFM | Sustainable Forest Management |
| TEK | Traditional Ecological Knowledge |
| UNEP | United Nations Environment Program |
| UNFF | United Nations Forum on Forests |
| USA | United States of America |
| USAID | United States Agency for International Development |
| USDA | United States Department of Agriculture |
| USFS | United States Department of Agriculture Forest Service |
| USGS | United States Geological Survey |
| WB | World Bank |

# Introduction

Global response to the emergence of the SARS-CoV-2 virus and the COVID-19 disease was typical of historic pandemics: isolation, social distancing, retreat from urban to rural areas, and border closures (Kenny, 2021). The responses of individuals, firms, and organizations was amplified, induced, or both by government actions. These responses cascaded through social and economic systems, disrupting manufacturing and services, travel, shipping, and other industries including forest products (Coskren, 2020). The World Bank projected a 2.09% to 3.86% contraction in global GDP; GDP of the USA was expected to fall 1.67% to 3.40% below base line and Canada 1.57% to 3.18% (Maliszewska *et al.*, 2020). Governments responded to the immediate and anticipated impacts on the economy and employment with actions to alleviate the effects of the disruptions caused by efforts to contain the spread of the virus.

The SARS-CoV-2 virus has been likened to the influenza virus and the current pandemic to the so-called Spanish Flu epidemic of 1918-1920 (Chandra *et al.*, 2021; Liang *et al.*, 2021b). Nevertheless, there is reason to question whether this is an accurate model of COVID-19. It is uncertain if COVID-19 will become endemic and recur in phases, or if there will be sporadic outbreaks, or the very unlikely future where it disappears altogether (Shaman and Galanti, 2020; Baker *et al.*, 2021). This uncertainly renders any long-term assessment of COVID-19 speculative (Nikolopoulos *et al.*, 2020); the emergence of the highly transmissible Omicron variant in 2021 demonstrated the ability of the virus to evolve[1].

In 2020, there were three pandemic waves in the USA, during spring, summer, and autumn–winter. At the end of the year, an estimated 69% of the population were still at risk of COVID-19 infection (Sen *et al.*, 2021). From February 2020 until mid-October 2021, 722,000 people in the USA have died from the virus, although this is likely an underestimate. The peak in deaths attributable to COVID-19 occurred in January 2021, a daily average mortality of more than 3,100 people. Availability of effective vaccines, mask mandates, and social distancing caused deaths to decline in spring and early summer of 2021, but the more contagious Delta variant caused a resurgence of cases in July. The more easily transmissible Omicron variant that emerged in late 2021 appears to cause less severe symptoms and fewer deaths; nevertheless, 132,646 people were hospitalized with COVID-19 in January 2022, surpassing the record of 132,051 set in January 2021[2]. Nearly every part of the country has been affected, with the greatest impact in states with low vaccination rates[3].

Canada has experienced four peaks of daily COVID-19 case counts, with 1.68 million cases and 28,493 deaths by mid-October 2021[4]. Nationally, case counts have slowed, and longer-range

[1] Centers for Disease Control, First Confirmed Case of Omicron Variant Detected in the United States; 1 December 2021, https://www.cdc.gov/media/releases/2021/s1201-omicron-variant.html

[2] Reuters, U.S. breaks COVID-19 hospitalization record at over 132,000 as Omicron surges; 10 January 2022, https://www.reuters.com/world/us/us-breaks-covid-19-hospitalization-record-omicron-surges-2022-01-10/

[3] Washington Post https://www.washingtonpost.com/graphics/2020/national/coronavirus-us-cases-deaths/ accessed October 17, 2021.

[4] https://www.worldometers.info/coronavirus/country/canada/ accessed October 17, 2021.

forecast suggests that, at current levels of transmission, the fourth wave could decline in the last quarter of 2021. Driven by the Delta variant, the fourth wave has caused significant strain on health systems in heavily impacted areas with lower vaccination coverage, particularly in the western provinces with the highest caseload in western Alberta. Vaccines appear to be highly effective and over 88% of eligible people, aged 12 years or older, have received at least one dose and over 82% are fully vaccinated nationwide. New cases were 10 times higher among unvaccinated people than the fully vaccinated and hospitalization was 36 times higher among unvaccinated people than those fully vaccinated[5].

The United Nations Forum on Forests (UNFF) Secretariat commissioned an initial assessment of the impact of the COVID-19 pandemic on sustainable forest management (SFM), the forest sector, forest-dependent people, indigenous peoples and local communities, and forest financing and international cooperation. The results of regional assessments were presented at a virtual expert group meeting on the impact of COVID-19 held from 19 to 21 January 2021. A synthesis of the potential responses and measures for the recovery of the forest sector and enhanced contribution of forests to inclusive SFM was presented at the sixteenth session of the Forum (UNFF16).

The UNFF secretariat subsequently was requested to assess the challenges faced by countries, and the strategies, recovery measures, and best practices for reducing the impact of the impact of COVID-19 on forests and forest sector. The Secretariat again commissioned regional assessments that will be incorporated in the official documents for consideration of UNFF17. This report is one of the regional assessments, looking at North America (Canada and the United States of America). The report is structured around the three questions posed by the Secretariat:

- What are the challenges faced by countries in addressing the impacts of COVID-19 pandemic on forests and the forest sector?
- What strategies and recovery measures are being adopted by countries in combatting the impacts of the COVID-19 pandemic on forests and the forest sector?
- What best practices have been adopted by countries and other stakeholders for reducing the impact of COVID-19 on forests and forest sector?

## Methods

Information on the effects of COVID-19 was derived from existing published studies and reports, news items, and policy briefs, amplified by information from interviews. Existing published studies and reports, news items, policy briefs were identified by searching on Google (COVID-19 effects forest industry, COVID-19 effects forest, COVID-19 impact on forests), (Canada COVID-19 impact on forests, USA COVID-19 impact on forests) and Google Scholar

[5] Public Health Agency Canada. 2021. Update on COVID-19 in Canada: Epidemiology and Modelling. Accessed 17 October 2021 at https://www.canada.ca/content/dam/phac-aspc/documents/services/diseases-maladies/coronavirus-disease-covid-19/epidemiological-economic-research-data/update-covid-19-canada-epidemiology-modelling-20211008-en.pdf

(search terms included USA COVID-19 impact on forests, Canada COVID-19 impact on forests, COVID-19 forest fires).

Additional information was solicited from UNFF national focal points in the region through a short questionnaire. The same semi-structured questionnaire was used to solicit information from relevant stakeholders, including civil society, local community and forest associations, private sector, academia and research practitioners, development partners, intergovernmental and other regional/sub-regional organizations, and relevant international organizations.

## The Challenges of the COVID-19 Pandemic

The challenges faced by countries in addressing the impacts of COVID-19 pandemic on forests and the forest sector are driven by the epidemiology of the virus (including the emergence of variants), responses by people and governments (including vaccine hesitancy and control measures implemented to control the spread of the virus), and changes in consumer behavior as a result (EDC, 2020; ILO, 2020; Stanturf and Mansuy, 2021; Wunder *et al.*, 2021). Initial assessments of the effects of the pandemic on forests and forest industry focused on short-term disruptions of supply and changes in consumer behavior (Stanturf 2021). Forests, however, were not untouched by the pandemic. Nevertheless, the forest sector in North America—forest management, industry, and communities—demonstrated remarkable resilience to the COVID-19 pandemic (Stanturf and Mansuy 2021).

The future of SARS-CoV-2, including the possibility of elimination and eradication, remains uncertain, but much hinges on characteristics of SARS-CoV-2 immunity (Baker *et al.*, 2021). The effects of the pandemic will manifest for some time still, as the first-, second-and third-order impacts of the virus manifest over different time frames, in different countries (Fisayo and Tsukagoshi, 2021). A return to some form of normalcy in a post-pandemic world depends upon how the virus evolves, how well vaccines protect against new variants, and the success of vaccine distribution efforts (Shaman and Galanti, 2020; Baker *et al.*, 2021).

The COVID-19 global pandemic elicited extraordinary responses from governments worldwide. Initial efforts focused on the containing the spread of the virus by restricting mobility through border and travel restrictions and by imposing limits on social interactions that included social distancing and closing workplaces and schools. As these measures imposed economic costs and unemployment (Lund *et al.*, 2020; Walmsley *et al.*, 2020), various government programs in Canada and the USA (Table 1) sought to ease the pain through financial support to businesses and agencies and expanded unemployment benefits, among others (Department of Finance Canada, 2020; Senate Committeee on Appropriations, 2020; US Congress, 2020; US Senate, 2020).

Table 1 Legislation and Executive Orders in 2020-2021 enacted in response to the COVID-19 pandemic in the USA

| Date | Legislation | Intent | Effect on Forest Industry |
|---|---|---|---|
| 6 March 2020 | Coronavirus Preparedness and Response Supplemental Appropriations Act | Provided US$ 8.3 billion in emergency funding to federal agencies | • Manufacturing and procuring vaccines, medical supplies, and personal protective equipment<br>• Loans for affeced small businesses |
| 18 March 2020 | Families First Coronavirus Response Act | Funding for free COVID-19 testing, 14-day paid leave for affected workers, increased funding for food stamps | • Unemployment compensation<br>• Required employers to provide paid sick leave to COVID-affected employees |
| 27 March 2020 | US Federal Government Conoravirus Act, Relief, and Economic Security (CARES) Act | Supported economic response for public health, state and local government personnel, and businesses | • Established Paycheck Protection Program (PPP)<br>• Expanded COVID-19 testing |
| 24 April 2020 | Paycheck Protection Program (PPP) and Health Care Enhancement Act | Increased funding to the PPP and for hospitals and COVID-19 testing | • Additional PPP support for payrolled employees during shut downs |
| 27 December 2020 | US Congress 2019-2020 | Stimulus and enhanced unemployment benefits; new round of PPP loans and funding | • Additional PPP support for payrolled employees during shut downs |
| 20 January 2021 | Executive Order (EO) on Organizing and Mobiulizing the US Government to Provide a Unified and Effective Response to Combat COVID-19 and Provide Global Leadership | Swift and aggressive action by US Government to combat COVID-19 | • Vaccination program to reach all citizwens and increases availability of PPE |
| 20 January 2021 | Paris Climate Agreement | Renews US participation in the UN agreement including GHG emissions mitigation, climate change adaptation, and finance | • Supported bioenergy as a renewable energy option to replace fossil fuels<br>• Supported reduction in use of fossil fuels<br>• Supported carbon sequestration in forests |

Individuals' responses to the isolation and social distancing imposed to reduce the spread of the virus have profoundly affected employment, consumption, and recreation. Business closures and worker layoffs were early responses. Where possible, people continued to work remotely, including schools. Full and partial openings have resulted in hybrid work/learning arrangements that have ping-ponged between closures and full or partial openings as virus caseloads rose and fell. Generally, remote work has taken over the global corporate sector and is likely to continue because many workers are demanding it. In a survey by Accenture[6], 83% of 9,000 workers said they preferred a hybrid work model, and Global Workplace Analytics[7] predicted that 25-30% of the workforce would be working from home multiple days a week by the end of 2021.

Positions that cannot be done remotely, for example in the service and hospitality industries, were hit hard by the initial restrictions on gathering that forced business closures and left them unemployed (Montenovo *et al.*, 2020; Lee *et al.*, 2021). Many workers have been reluctant to return to low-paying jobs, causing an apparent labor shortage and pushing up wages (Levanon *et al.*, 2021). Hybrid school schedules and lack of available childcare have disproportionately affected female workers who remain unavailable to return to the workforce. Other workers in low paying or high-stress jobs that were deemed essential, have left the workforce, or taken other jobs. Taking all these factors altogether, the pandemic has roiled labor markets and caused many people to reassess the nature of their jobs, what has been called the "Great Reassessment" of employment[8] and causing a shortage of workers, mostly in blue-collar industries[9].

Masking and vaccination mandates have added to the turmoil in labor markets. The Biden administration in the USA has mandated vaccination for federal workers and contractors[10] as well as healthcare workers and extended this to the private sector. Pushback has come in the form of some highly publicized refusals from nurses, teachers, and law enforcement (Hodge *et al.*, 2021; Manning *et al.*, 2021) and legal challenges[11]. Nevertheless, most people in the USA are likely to be vaccinated[12]. Surveys in Canada reported willingness to be vaccinated at 82% in March 2021, with regional variation among provinces and territories (MacDonald *et al.*, 2021).

Consumption patterns switched from service-related expenditures (e.g., travel and dining) to buying goods, increasingly purchased on-line. As people sought relief from isolation in the

[6] https://www.accenture.com/us-en/insights/consulting/future-work accessed 18 October 2021
[7] https://globalworkplaceanalytics.com/work-at-home-after-covid-19-our-forecast accessed 18 October 2021
[8] https://www.washingtonpost.com/business/2021/09/04/ten-million-job-openings-labor-shortage/ accessed 18 October 2021
[9] https://conference-board.org/pdfdownload.cfm?masterProductID=20471 accessed 18 October 2021
[10] https://www.whitehouse.gov/covidplan/
[11] American Hospital Association, Blog: Updates on Legal Challenges to CMS and OSHA Vaccine Mandate Rule, 7 January 2022; https://www.aha.org/news/blog/2021-12-01-blog-updates-legal-challenges-cms-vaccine-mandate-rule
[12] https://covid.cdc.gov/covid-data-tracker/#datatracker-home; 77.5% of people 12 years of age or older had received at least one dose as of 22 October 2021.

outdoors, sales of recreational clothing boomed[13]. An increase in home remodeling and do-it-yourself home improvements[14] caused higher lumber prices and local shortages through the summer of 2021[15]. Abetted by the ability to work remotely, some mostly white-collar workers sought more space and rural lifestyles, migrating from urban areas to suburbs and farther out, invigorating construction of single-family dwellings[16].

The shift in consumer spending from services to goods has disrupted supply chains and caused product shortages and capacity constraints in the freight sector (Dunn, 2021). Notable instances of panic buying and hoarding (Islam *et al.*, 2021) affected especially the demand for hygiene products resulting in localized shortages of toilet paper (Stanturf, 2021). Supply chain disruptions are likely to continue to evolve and persist (Dunn, 2021).

## Impacts on the forest products sector

The long-term outlook for the forest products sector, indeed the overall economies of the USA and Canada, depends primarily on the emergence of COVID variants and future waves, continued vaccine effectiveness, and vaccination rates. The impact of new variants, the ability to manage transmission, and whether they would cause another wave of lockdowns requiring economic responses are unknowns[17]. Businesses seem to have adopted the outlook that public-health responses will contain the virus, a change from earlier attitudes where the most likely scenario was recurring surges of the virus, although at the time of writing, the emergence of the new Omicron variant has injected new uncertainty[18]. Supply-chain disruptions and labor shortages are now the top concern among respondents in North America in all sectors, outpacing COVID[19]. Worker shortages are a concern for the forest industry. Hauling is the

[13] Deep Dive, 23 February 2021, The outdoors boom spared many retailers from the harshest impacts of COVID; https://www.retaildive.com/news/the-outdoors-boom-spared-many-retailers-from-the-harshest-impacts-of-covid/594900/

[14] Forest2Market, September 21, 2020. BREAKING: Have North American Lumber Prices Peaked? https://www.forest2market.com/blog/breaking-have-north-american-lumber-prices-peaked

[15] Bloomberg, 26 October 2021, Pricey Lumber Is Back Boosted by Supply Cuts, Labor Shortage; https://www.bloomberg.com/news/articles/2021-10-26/expensive-lumber-is-back-boosted-by-supply-cuts-labor-shortages

[16] Washington Post, 15 October 2020, https://www.washingtonpost.com/realestate/choosing-the-suburbs-over-city-life-during-the-pandemic/2020/10/15/01c94c5e-e716-11ea-97e0-94d2e46e759b_story.html.

[17] Economic Development Canada, 21 October 2021. Top 10 global trends in 2021. https://www.edc.ca/en/article/edc-top-10-trends-2021.html?utm_source=ti&utm_medium=edc-email&utm_campaign=content_customer-tradeinsights%E2%80%A6

[18] Business Standard, 29 November 2021. Worst case scenario: Economists analyse how omicron will impact recoveryhttps://www.business-standard.com/article/international/how-covid-variant-omicron-will-impact-global-recovery-economists-evaluate-121112900293_1.html

[19] McKinsey, 29 October 2021. The coronavirus effect on global economic sentiment. https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-coronavirus-effect-on-global-economic-sentiment?hctky=1991373&hdpid=7e0ff504-6ddb-426c-b613-b16103730959&hlkid=f54ec846df194b00ba237d4c6cdc29f8; Forests2Market, 29 September 2021. Pandemic-Fueled Uncertainty Continues to Hobble Labor Market. https://www.forest2market.com/blog/pandemic-fueled-uncertainty-continues-to-hobble-labor-market?utm_medium=email&_hsmi=165355557&_hsenc=%E2%80%A6

weakest link in the wood supply chain and there is a shortage of drivers, who face age restrictions due to insurance and regulations and insurance. Industry has shown interest in out-sourcing to third-party hauling providers, with added benefits of improved logistics and planning infrastructure to optimize the available hauling capacity[20].

The pandemic has accelerated the decreased demand for newsprint, and commercial copying and printing paper while at the same time, increased demand for containerboard used in shipping packaging. Despite the overall decline in economic activity caused by closures and layoffs, e-Commerce supports containerboard demand for shipping packages[21]. One estimate is that e-commerce uses seven times more corrugated material per $US spent than sales at bricks-and-mortar stores[22]. E-commerce drove demand for corrugated and containerboard in 2020 and seems to have caused a structural change with consumers preferring online. Mill capacity in North America for producing containerboard is expanding.[23]

Continued remote work and on-line schooling is driving a further decline in demand for graphic paper that will cause mills to shut down or switch to making other products. Demand for some printing and writing products is likely to recover but not to pre-pandemic levels. Fewer in-person meetings mean reduced need for copies of documents and agendas for participants.

Tissue and nonwovens will continue to be in demand for hygiene and personal protection products. Shifts in demand from away-from-home tissue and hygiene to at-home use products, manufacturers will have to accommodate packaging products in smaller quantities[24]. At-home products generally require higher-quality fiber than away-from home products, causing a shift toward pulp with more virgin fiber. Several mills in the USA and Canada have already ceased producing graphic papers or converted to producing fluff for tissue (Stanturf, 2021).

Building construction drives demand for lumber, plywood, and related materials. The housing market is the primary driver; continued grow in remote working and learning will increase demand for solid wood and panel products. Spending on DIY (home improvement and maintenance) is expected to increase through the second quarter of 2022[25]. The emphasis on

[20] Forisk blog, 2 November 2021. Supply Chain Discussions Go mainstream…Unfortunately. https://forisk.com/blog/2021/11/02/supply-chain/

[21] McKinsey. July 2020. Beyond COVID-19: The next normal for packaging design. https://www.mckinsey.com/industries/paper-forest-products-and-packaging/our-insights/beyond-covid-19-the-next-normal-for-packaging-design

[22] RISI, 15 July 2019, E-commerce is powering paper packaging demand, but its impact will weaken over next 5 yearshttps://www.risiinfo.com/press-release/e-commerce-is-powering-paper-packaging-demand-but-its-impact-will-weaken-over-next-5-years/

[23] Forest2market 16 November 2021 Covid super-charged e-commerce and packaging what's next? https://www.forest2market.com/blog/covid-supercharged-e-commerce-and-packaging-whats-next?utm_campaign=Fisher%20Corrugated%202021&utm_content=187554922&utm_medium=social&utm_source=linkedin&hss_channel=lcp-831906 Accessed 19 November 2021

[24] McKinsey. July 2020. Beyond COVID-19: The next normal for packaging design. https://www.mckinsey.com/industries/paper-forest-products-and-packaging/our-insights/beyond-covid-19-the-next-normal-for-packaging-design

[25] Joint Center for Housing Studies, 15 July 2021. Further strengthening expected for home remodeling. https://www.jchs.harvard.edu/blog/further-strengthening-expected-home-remodeling.

single family rather than multiple family units in both the USA and Canada substantially affects lumber demand[26]. A median-sized single-family home uses about three times more lumber than the median multi-family building[27].

Housing demand during the pandemic has been greater in low density neighborhoods than in areas with higher population density, because of the increased telework opportunities (Liu and Su, 2021). The hot housing construction scene cooled in September 2021, but the single-family sector remained steadier than multi-family starts although both face shortages of building materials[28]. Government intervention to keep interest rates low has supported new home buyers but interest rates are likely to increase. Nevertheless, there is a large unmet need for housing in the USA, exacerbated by the pandemic with the shortage increasing 52% from 2.5 million in 2018 to 3.8 million in 2020[29].

Over time, the rise of remote working [30] will dampen the demand for commercial office space and likely cause a repurposing of retail spaces. For example, if office workers continue to work remotely one day a week, that translates into a potential 20% reduction in demand for commercial space[31].

Bioenergy production, specifically pellet mills, is an important industry in the southern USA. Mills typically take advantage of large volumes of standing timber with relatively low value (i.e., low stumpage price) or locate where other forest industries (i.e., sawmills) generate large volumes of woody residues (Dale *et al*., 2017; Kline *et al*., 2021). There was little change in pellet production pre- and post-pandemic (Kline *et al.*, 2021). The pandemic did affect labor availability in the pellet industry, like the other forest industries. The entire sector was declared essential but early in the pandemic PPE equipment was in short supply, and later following social distancing and masking rules was a problem. Once workers contracted COVID-19, skilled replacements were not available and some mills had to shut-down for 2–6 weeks (Kline *et al.*, 2021).

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[26] Forest2Markets October 27, 2020. Single-Family Building Boosts Housing Starts Higher in September. https://www.forest2market.com/blog/single-family-building-boosts-housing-starts-higher-in-september?utm_medium=email&_hsmi=98433943&_hsenc=p2ANqtz-9QhLGgqVJ3JVDQr2PXqPI3Ph2ZX0BKWOJPsrneIjv05mYEPrWaqiGCUYhG_45pvhSKxpXcenisVzToWDB0scotyoegJg&utm_content=98433943&utm_source=hs_email

[27] RISI Info. July 2020. Uncertainty in forest products markets. https://insights.risiinfo.com/ufpm-report-2020/index.html

[28] Greene, John. Forest2markets, 25 October 2021. September Housing Starts Down as Market Continues to Cool. https://www.forest2market.com/blog/september-housing-starts-down-as-market-continues-to-cool?utm_campaign=Lumber

[29] Freddie Mac Research Note, 7 May 2021, Housing Supply: A Growing Deficit. http://www.freddiemac.com/research/insight/20210507_housing_supply.page

[30] Major companies in the US and other countries have announced plans to continue remote working arrangements well into 2021 or even permanently for some employees. (https://www.wsj.com/articles/for-many-remote-work-is-becoming-permanent-in-wake-of-coronavirus-11590100453 ; https://www.forbes.com/sites/jasonwingard/2020/05/22/remote-working-how-to-succeed-over-the-long-term/?sh=771034745469 ; https://www.flexjobs.com/blog/post/companies-switching-remote work-long-term/

[31] Interview with Daowei Zhang, October 15, 2020.

Getting experienced and well-trained workers with specialty skills, such as loggers and truck drivers has been difficult in some regions[32] (Kline *et al.*, 2021). Other factors play a role, for example the availability of seasonal workers under the H-2B temporary labor visa program. Due to labor shortages across the board in the USA, the cap on these visas was reached on September 30, 2021, the earliest that the first half H-2B cap has ever been reached. These H-2B workers are critical for reforestation efforts in the USA and their availability is time sensitive with the planting season restricted to the period from October to February[33].

Workforce dynamic in Canada is quite different than in the USA[34]. In Canada, many of the jobs are in remote locations and forestry jobs pay better with benefits than alternatives. Competition comes from extractive industry; if a mine opens, forestry workers may move due higher pay although recent boom/bust cycles in oil and gas (O&G) have made these jobs less attractive. In fact, workforce training programs now are aimed at reskilling/upskilling O&G workers. People moving out of urbanized areas to rural locations because of high home prices, etc. are potential skilled forestry workers.

Pandemic-related problems are due to the high rate of absenteeism due to

**Effects of COVID-19 on Kansas State Parks**

Revenue and visitation have hit historic highs, but so have expenses. Utilities were higher because users stayed longer. Other costs were purchasing COVID supplies, and additional costs in cleaning shower buildings, restrooms, and cabins. Staffing costs increased; we had to increase our hourly rate to get seasonal during the prime season. We have yet to realize the cost to our infrastructure from the high capacity of users. We had record numbers, but will we be expected to keep that level up without additional financial support?

Staffing is still difficult; staff are tired from working so hard to keep the crowds under control. Volunteers didn't want to work during the height of the pandemic. It is difficult to get qualified applicants to fill job openings. The last 18 months have been difficult to recruit and retain camp hosts. We believe they did not want to be around the public. This is getting a bit better.

Our staff faced health issues; some contracted COVID and had long-term effects. No staff died, but some who had once worked for us did.

Kansas state parks stayed open, but we shut offices, went 100% reservation, and worked through phones and windows; no visitors were allowed in the offices. We closed cabins between stays and closed shower buildings during cleanings. Some were closed, and we kept only a few restrooms open. Some users expected more after things opened this past year and we had more complaints. The positives were that we gained new users that had never driven a boat, never backed a camper into a campsite, and never fished. We spent a lot of time educating our new users about park rules, park amenities, and what great activities they could do in a state park. The challenge will be to retain these new customers.

[32] Forest2Market, Pandemic-fueled uncertainty continues to hobble labor market, 29 September 2021. https://www.forest2market.com/blog/pandemic-fueled-uncertainty-continues-to-hobble-labor-market?utm_medium=email&_hsmi=165355557&_hsenc=%E2%80%A6

[33] Forest Landowners Association, 23 November 2021, U.S. Labor Shortage Cause Ripple Effect with Seasonal H-2B Forestry Workers. https://www.forestlandowners.com/u-s-labor-shortage-cause-ripple-effect-with-seasonal-h-2b-forestry-workers

[34] Interview with Derek Nighbor, Forest Products Association of Canada, 19 January 2022.

isolation/quarantine requirement for those with COVID[35]. There is a truck driver shortage, partly due to the vaccine mandate at the border. All in all, there is a need for an expanded temporary foreign worker program in Canada.

## The effects on forests

People responded to the isolation of social distancing by going outdoors. The relatively safer conditions of outdoors and desire for a release from inaction have driven an increase in demand for outdoor recreation experiences. The immediate impact of more visitors to parks and public forests, along with decreased numbers of employees and volunteers to provide necessary operations and maintenance duties, including fee collection, has been an increase in vandalism, littering, and over-taxing of infrastructure. Longer-term effects of reduced public sector budgets will add to the backlog in maintenance funding for public outdoor recreation facilities. The experience of Kansas state parks illustrates (sidebar) the impact[36]. Visits to campgrounds in New York State (Fig. 1) rebounded in 2021, after declining during the early year of the pandemic.

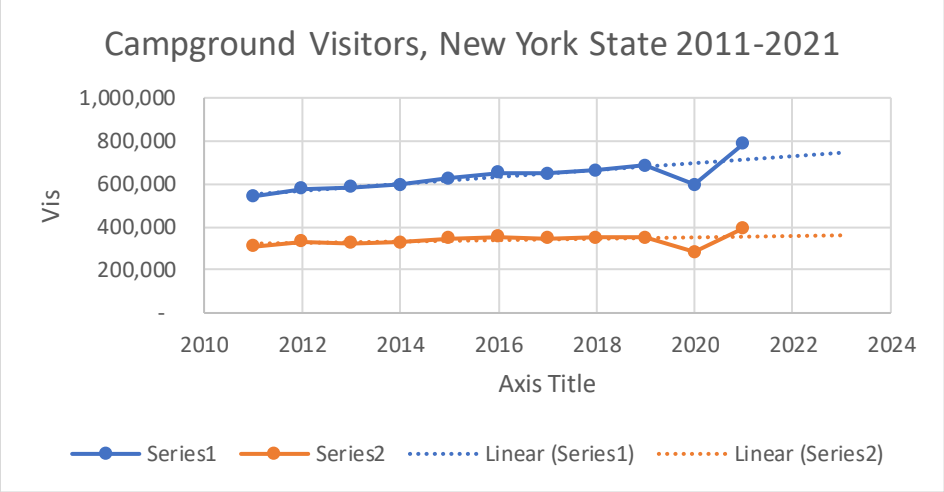


*Figure 1 Campground Visitors, New York State Parks 2011-2021.*

Visitors to campgrounds operated by the New York State Office of Parks, Recreation and Historic Preservation (State Parks) were up 15 % in 2021 from the pre-pandemic record set in 2019 (Series 1) and more than 10 % from the 2016 record (Series 2) at campgrounds operated by New York State Department of Environmental Conservation Source: Governor's Office[37]

[35] Washington Post 20 January 2022, Workers are out sick in record numbers, exacerbating labor shortage woes; https://www.washingtonpost.com/business/2022/01/20/workers-out-sick-omicron-census/

[36] Interview with Linda Lanterman, Director of Kansas State Parks, 25 October 2021.

[37] https://www.governor.ny.gov/news/governor-hochul-announces-record-breaking-number-stays-new-york-state-campgrounds-2021?utm_medium=email&utm_source=govdelivery

The COVID-19 pandemic will have long-term social consequences. Just as the pandemic has exposed racial injustice in society, COVID-19 has highlighted environmental justice issues[38] and many of the impacts occur in rural as well as urban areas. Rural residents have less access to healthcare and greater vulnerability to labor downturns (Mueller *et al.*, 2021). In some areas, outdoor spaces are being occupied by the homeless and unemployed, contributing to a long-term problem on national forests (Cerveny and Baur, 2020).

Business closures in tourism-dependent communities have been significant, especially the long-term consequences of outdoor recreation businesses that do not survive. Lockdowns, travel restrictions, and risk perceptions significantly reduced foreign tourists in cities (Liang *et al.*, 2021a) and probably had similar effects on outdoor recreation in rural areas, with an approximately 26% reduction in trips per participant to public outdoor recreation sites post-COVID-19, as compared to pre-COVID-19 trips in the USA (Landry *et al.*, 2021). Long-term, recreation usage patterns that changed during the pandemic are likely to persist post-pandemic (Rice *et al.*, 2020). Research by the Outdoor Industry Association [39] found greater diversity in new participants (more likely to be female, younger, urban, ethnically diverse). They were seeking socially distanced outdoor activities with low barriers to entry that were near their homes (within 10 miles). In Canada, many outdoor recreation and natural resource areas initially remained open but then provincial, national, and regional parks, and conservation areas closed due to overcrowding and lack of adherence to physical distancing guidelines (O'Connell *et al.*, 2020).

The impact of the pandemic on visitation to national parks has been considerable. In Utah, for example, there are five national parks with 15.3 million visitors. Their US$ 1.2 billion in spending in 2019 on goods and services in gateway communities supported 18,900 jobs, (National Park Service, 2021). COVID-19 closures in one national park, Arches, resulted in approximately 404,000 fewer visitors between March and May 2020 but by August, visitation had rebounded to near average levels (Spenceley *et al.*, 2021). Communities living around national parks were the hardest hit, with the highest unemployment rates in Utah. In Canada, pandemic restrictions had similar impacts on provincial park visitation (Spenceley *et al.*, 2021). The decline in visitation during the COVID years (2019-2020) is illustrated by Yellowstone National Park in the western USA, and by Gettysburg National Military Park in the more populous eastern USA (Figure 2).

Outdoor recreationists using guided tours operate on public and private forest land. Tour operators were disrupted by the pandemic. One operator that normally offers tours in the western USA (Adventure Treks) decided the "logistical and potential quarantine challenges were too great should something has gone wrong" and instead switched to operating their 12-acre basecamp in western North Carolina. They followed guidelines from the American Camp

[38] Connecting the dots between environmental justice and the coronavirus, 7 May 2020, https://e360.yale.edu/features/connecting-the-dots-between-environmental-injustice-and-the-coronavirus

[39] Outdoor Industry Association 2021 Special Report: The New Outdoor Participant (COVID And Beyond) https://oia.outdoorindustry.org/l/51282/2021-03-29/dg2r2l/51282/1617064883iebKFnqB/New_Outdoor_Participant__COVID_and_Beyond___FINAL.pdf

Association and North Carolina Department of Health and Human Services and avoided any COVID-related incidents in the summer of 2020[40].


*Figure 2. Visitors to Yellowstone National Park and Gettysburg National Military Park, 2000-2020.*

The drop in 2019 and 2020 is due to COVID-related closures and restrictions. (Source: National Park Service, https://irma.nps.gov/STATS/SSRSReports/ )

The greatest impact of COVID-19 on forest management in 2020 was on wildland fire activity in the USA (Stanturf and Mansuy, 2021). Changes were made in firefighter camps and restrictions on crew travel, with good effect (Crockett, 2021). These measures were less effective in 2021,

[40]Adventure Treks' COVID-19 Resources, https://www.adventuretreks.com/current-families/adventure-treks-coronavirus/

with more firefighters falling ill with COVID-19 and quarantining in 2021 than in 2020 [41]. This was likely due to the more contagious delta variant and less adherence to safety measures (masking, vaccinations, and social distancing). Restrictions on prescribed fire use was apparent from satellite data, with a 21% reduction in fire activity in the southeastern USA compared to the 2003 to 2019 average. The reduction on federally managed lands was even greater, up to 41% below the 20-year average. (Poulter *et al.*, 2021). Fire return intervals are only 1-2 years in the southeast (Stanturf *et al.*, 2002) and the interruption in normal activity due to COVID-19 increases the backlog in necessary hazardous fuel reduction, affecting biodiversity and increasing future fire danger (Poulter *et al.*, 2021). A changing climate compounds the risk of lengthier fires seasons with greater frequency of mega-fires (Williams and Hyde, 2009; Liu *et al.*, 2010; Liu *et al.*, 2013).

The non-industrial privately owned forests of the eastern USA are primary sources of timber. These non-industrial private forest landowners (NIPFL) are a diverse group with multiple reasons for owning, and occasionally harvesting, forest land (Butler *et al.*, 2016). They have responded to the COVID-19 constraints in typically diverse fashion. Although most reported that they would not alter their forest management or timber harvest practices, fully 25% of them said they would likely manage less while 14% said they would manage more (Hilsenroth *et al.*, 2021). Some of the differences were likely related to location and the early constraints imposed by their state government. For example, NIPFL in Arkansas were the most likely to report no impact on their management practices and Arkansas was the only state in the southeastern USA that did not impose an early stay-at-home order (Moreland *et al.*, 2020). Economics and race also played a role in whether a NIPFL would engage in less management; NIPFL in Louisiana and Oklahoma were the most likely to manage less and these states suffered the greatest economic impact of COVID-19[42] and Louisiana had the largest change in employment of the southeastern states. Because most management activities would mean out-of-pocket expenses for the landowner, NIPFL in these states would have the least ability to bear these expenses. Non-white landowners also were the most likely to manage less (Hilsenroth *et al.*, 2021), which was probably related to their economic condition.

Protected area (e.g., national parks) management has also been disrupted by the pandemic (Miller-Rushing *et al.*, 2021). Similar to the effects on state parks, national parks have suffered from reduced staffing and decreased revenues, with effects on operational priorities. Further, long-term research and monitoring have been interrupted and management activity delayed (e.g., control of invasive plants, restoration of degraded habitat, and prescribed burning). Public engagement such as interpretive programs have gone virtual, rather than the more intimate in-person experiences with park rangers (Miller-Rushing *et al.*, 2021).

[41] Quinton, Sophie. Stateline, Pew Charitable Trust. COVID Hits Wildfire Fighters Even Harder Than Last Year. https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2021/09/15/covid-hits-wildfire-fighters-even-harder-than-last-year

[42] Ettlinger, M., Hensley, J., 2021. COVID-19 Economic Crisis: By State. University of New Hampshire Carsey school of Public Policy 2021. https://carsey.unh.edu/publication/COVID-19-Economic-Impact-By-State

## Strategies and Recovery Measures

Three recovery strategies were suggested early in the pandemic: Build Back Better, Green/Low-Carbon Economy, and Forest Restoration (Stanturf and Mansuy, 2021). The experiences of lockdown and social distancing show that significant societal changes are possible (Stark, 2020). Nevertheless, social policy responses in Canada and the USA differed; the Canadian government responded faster than the government in the USA (Béland *et al.*, 2021). The differing response is likely due to a combination of pre-existing political institutions and policy legacies (e.g., major differences in the health care systems between the neighbors) as well as striking differences in consensus/dissensus (Béland *et al.*, 2021). Despite these differences, both countries face the reality of compound shocks that interact in complex ways (McNeely, 2021; Ranger *et al.*, 2021).

Just as the COVID-19 pandemic has highlighted how ill-prepared we are to respond to natural disasters, it as well accords hope for a more sustainable future (Duflot *et al.*, 2021). Targeting recovery funds towards activities that mitigate climate warming and biodiversity loss, rather than to "Business-As-Usual" support for existing carbon intensive industries such as energy production could help meet the Paris Agreement objectives (Andrijevic *et al.*, 2020).

The forest products industry has great potential to lead the movement to Build Back Better in a Circular Economy. While linking the bioeconomy to post-pandemic recovery is currently in vogue, there is limited data on the effects of COVID on the bioeconomy (Fritsche *et al.*, 2021). Nevertheless, the stimulus packages being discussed (the IIJA and Build Back better in the USA) could stimulate various nature-based solutions including forest restoration. The International Union for Conservation of Nature (IUCN) defines nature-based solutions as "*actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits*". The importance placed on benefits to both human well-being and biodiversity should be noted. Specific actions within the scope of nature-based solutions include:

- Protecting forests with existing high carbon stocks and biodiversity value
- Restoring forests in which carbon stocks and biodiversity are at risk
- Managing forests to provide biomass resources, whilst conserving or increasing carbon stocks and biodiversity
- Creating new forest areas, to provide additional biomass resources, whilst enhancing terrestrial carbon stocks and biodiversity (Fritsche *et al.*, 2021; Ibn-Mohammed *et al.*, 2021).

### Integrating sustainable forest management into pandemic recovery plans

Restoring degraded forests in the USA and Canada could potentially contribute to the Green Economy, reduce carbon emissions, sequester carbon, adapt to climate change, and create jobs (Stanturf *et al.*, 2015; Mansuy *et al.*, 2020). Both countries have proposed to scale up tree

planting, on the order of billions of trees (Mansuy *et al.*, 2020)[43]. An estimated US$4-4.5 billion annual investment over 20 years, planting 60 billion trees, mostly on private lands, could create 150,000 jobs per year (US$ 1 million invested in reforestation creates 40 jobs (Edwards *et al.*, 2013)[44]. Currently the Green/Restoration economy in the USA is estimated to directly employ about 126,000 jobs and indirectly an additional 95,000 jobs with US$ 24.5 billion in total economic activity (BenDor *et al.*, 2015).

The US government passed the Infrastructure Investment and Jobs Act (IIJA) that included billions of dollars dedicated to nature-based solutions (Table 2). The IIJA in the USA includes portions of the REPLANT Act aimed at reforestation on public land (i.e., the National Forest System). It directs the USFS to identify areas in need of reforestation and provides an additional US$80-US$90 million annually to the Reforestation Trust Fund (currently capped at US$30 million annually). This will allow the US Forest Service to plant 1.2 billion trees on national forests[45]. The IIJA also provides US$200 million for a national seed and seedling strategy to bolster capacity.

Other features of the IIJA affecting forests in the USA are summarized in Table 2, generally aimed at reducing wildfire risk and restoring ecosystems. A total of US$5.5 billion is included in the legislation, mostly a one-time infusion of cash. Thus, it is unlikely the agencies will increase staffing to address these problems and more likely that the funds will be distributed to partners (states and tribes).

In addition to the US$3.4 billion allocated in the federal IIJA to address the wildfire problem, the governor of California, Gavin Newsom, has included US$1.2 billion over the next two years to wildfire, mostly for fire prevention. This includes US$482 million for projects creating more fire-resilient landscapes through a combination of reforestation, forest thinning, prescribed burns and livestock grazing programs. Fire suppression funding in the draft budget of US$284 million would pay for equipment, including adding four specialized helicopters capable of nighttime flights. The money would also help the state expand its permanent hand-crew staff, which has been in short supply[46].

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[43] White House. Executive Order on Establishing the One Trillion Trees Interagency Council. October 13, 2020. https://www.whitehouse.gov/presidential-actions/executive-order-establishing-one-trillion-trees-interagency-council/#:~:text=On. Fast Company. These are the companies leading the trillion trees effort in the U.S. https://www.fastcompany.com/90544563/these-are-the-companies-leading-the-trillion-trees-effort-in-the-u-s?partner=rss&utm_source=rss&utm_mediu%E2%80%A6 .

[44] WRI. Want to Help the US Economy? Rethink the Trillion Trees Act. August 26, 2020. https://www.wri.org/print/66273

[45] Forest2market, 9 November 2021, House passes $1.2trillion infrastructure bill: What's in it for forestry? https://www.forest2market.com/blog/house-passes-1.2-trillion-infrastructure-bill-whats-in-it-for-forestry

[46] San Francisco Chronicle 10 January 2022, Newsom's budget proposal would add billions to confront wildfire, climate change; https://www-sfchronicle-com.cdn.ampproject.org/c/s/www.sfchronicle.com/bayarea/amp/Newsom-s-budget-proposal-would-add-billions-to-16765523.php

The REPLANT Act only increases by an estimated additional US$90 million annually, but that number could be higher (maybe up to US$120 million) or about a US$1 billion by itself over the next decade. This is long-term infusion of cash and therefore more likely the USFS will allow hiring on these funds, increasing needed staff to develop the reforestation projects and do the work[47].

The Nature Conservancy has released an on-line application that identifies reforestation opportunities at the county level that includes filters for current land use and ownership. This Reforestation Hub[48] suggests that up to 133 million acres of formerly forested lands could be reforested; reforesting this entire area could absorb an additional 333 million metric tons of carbon per year American Forests[49]

Before these opportunities can be realized, two bottlenecks will need to be overcome: producing climate adapted seedlings of native plants (Fargione *et al.*, 2021; Stanturf *et al.*, In Press) and the labor force needed for planting. The current capacity of nurseries in the USA is 1.2 billion tree seedlings annually, enough to plant 2.2 million acres. The need for seedlings grows, particularly in the western USA, due to wildfires, droughts, diseases, and pest outbreaks. In addition to the capital required to increase the infrastructure, sufficient labor is a problem. Many nursery jobs are seasonal, relying on immigrant crews under the H2B temporary visa program. Some nurseries in remote areas rely on retirees with physical limitations. By one estimate, an additional 131 million acres are available for planting. To reach the often-touted goal of planting this area by 2030, 2.8 billion trees more seedlings would be needed each year, more than doubling the present production. An additional factor is the uncertainty of whether the demand for additional seedlings would persist long enough to recoup the capital investment a nursery would have to make to scale-up production[50].

A Canadian government program designed to help the forest sector adjust to the new requirements and associated costs of new health and safety measures for workers provided CN$30 million over one year. Included in this program was support for the tree planting season to continue in 2020 and meet forest regeneration requirements in Canada's Sustainable Forest Management regimes[51]. Over 600 million seedlings were planted[52]. Canada's 2 Billion Trees (2BT) campaign aims to plant two billion trees over 10 years and permanently increase forest cover (Fig. 3). The 2BT is a nature-based climate solution to mitigate climate change, conserve biodiversity, and provide well-being benefits to Canadian citizens. The 2BT program recognizes the need to ramp up seedling production and to provide stable demand over time. Thus, a 2- to 3-year production schedule, the time it takes to grow seedlings for most planting activities in

[47] Interview with Dr. Kas Dumroese, USFS Nursery Specialist; 10 January 2022.
[48] Reforestation Hub, https://www.reforestationhub.org/
[49] American Forests Reforestation Hub; https://www.americanforests.org/tools-research-reports-and-guides/reforestation-hub/
[50] American Forests Magazine Fall 2020 https://www.americanforests.org/magazine/article/growing-pains-the-race-to-plant-billions-of-trees/
[51] Interview with Margot Downey, Natural Resources Canada, based on COVID-related survey for the Montreal Process Working Group, 20 November 2020.
[52] Interview with Derek Nighbor, Forest Products Association of Canada, 28 October 2020.

*Table 2. Provisions of the IIJA affecting forests*[53]

| | | |
|---|---|---|
| **Wildfire Risk Reduction – US$3.4 billion** | | |
| • Increased wildland firefighter salaries | **US$600 million** | 80% USFS; 20% DOI |
| • Ecologically appropriate mechanical thinning and timber harvesting | **US$500 million** | 80% USFS; 20% DOI |
| • Wildfire control locations including ecologically appropriate shaded fuel breaks | **US$500 million** | 50% USFS; 50% DOI |
| • Remove flammable vegetation on federal land; use treatment materials for biochar and other innovative wood products | **US$200 million** | 50% USFS; 50% DOI |
| • Post-fire restoration activities within three years of fire containment date | **US$200 million** | |
| • Collaborative Forest Landscape Restoration Act projects | **US$100 million** | 100% USFS |
| • Creates a permanent Federal wildland firefighter job series; converts 1,000 seasonal to full-time employees | **US$20,000 or 50% salary increase** | USFS and DOI |
| **Ecosystem Restoration – US$2.1 billion** | | |
| • Loan guarantees or low-interest loans for wood using facilities that purchase byproducts of restoration treatments* | **US$400 million** | |
| • Ecological restoration on federal lands, for contracts for a minimum of 10,000 acres | **US$300 million** | 75% USFS; 25% DOI |
| • Matching payments to states and tribes for Good Neighbor Agreements | **US$200 million** | 80% USFS; 20% DOI |
| • Invasive pest detection, prevention, and eradication | **US$200 million** | 50% USFS; 50% DOI |
| • Abandoned mine land restoration | **US$200 million** | 50% USFS; 50% DOI |
| • Reforestation on both public and private lands | **US$200 million** | 65% USFS; 35% DOI |
| • Restore and improve recreation sites on federal land | **US$100 million** | 50% USFS; 50% DOI |
| • New collaborative landscape-scale restoration program to restore water quality or fish passage on federal land | **US$80 million** | |

*Facilities must be near a unit of federal land identified as a high or very high priority for ecological restoration and substantially decrease the cost of conducting ecological restoration projects.

[53] Source: Forest Landowners, 9 November 2021, https://www.forestlandowners.com/wp-content/uploads/2021/11/Infrastructure-Investment-and-Jobs-Act-Forestry-Related-Funding.pdf

Canada is recognized in the funding that ramps up quickly so that nursery capacity could increase by 40% (Fig 3). The launch in early 2021 of 2BT utilized overstocked seedlings in nurseries, planting 30 million seedlings in the first year (2021). The number of estimated seedlings planted increases slowly in the first four years of the program but then reaches over300 million trees planted annually starting in 2027 through 2030, the end of the program.

The Canadian government provided immediate COVID-19 assistance with programs like those in the USA (Stanturf, 2021). These federal government relief programs were aimed generally at industry, but forest products companies made little use of them as their markets were stable. Tourism, travel and other service industries were hit hard. Government's interest today is in financing and incentives directed at "decarbonization," mostly aimed at the extractive industries (mining), with a goal of net zero by 2050[54]. The suite of "shovel ready" projects that industry proposed (Stanturf, 2021) were somewhat funded, most dealt with pre-pandemic problems in this vein. The next government budget is due out in a few weeks.

The pandemic coincided with other environmental problems such as wildfire and floods (especially in western Canada). While the pandemic may have created a greater sense of urgency, the climate action agenda is getting the attention of government, with a major push on wildfire and public safety. Along these lines, a national adaptation strategy is developing, with a recognition that climate change mitigation will not fully address the problem. The insurance industry is getting involved in these discussions/debates[54].

Existing green infrastructure in cities and peri-urban areas has been shown during the Covid-19 pandemic to be of great value, even increasing in societal value during the pandemic, by providing relatively safe locations for physical and social interaction (Mell and Whitten, 2021; Weinbrenner *et al.*, 2021). Green infrastructure has a multitude of definitions and conditions (Mell and Whitten, 2021) but urban forests have many social, economic, cultural, and ecological benefits (Konijnendijk *et al.*, 2018). Urban growth and intensified land use is pressuring forests around cities, such that forest patches within cities increasingly provide biodiversity conservation as well as the ecosystem services they provide (Kowarik *et al.*, 2019). In addition to the plans and resources allocated to increase forest cover in cities and peri-urban areas by extensive tree plantings[55], spontaneous urban woodlands (Kowarik *et al.*, 2019) spontaneously on vacant or abandoned areas (e.g., brownfield sites such as former industrial, military, and agricultural uses). They may differ in species composition from near-natural forests (Trentanovi *et al.*, 2021).

[54] Interview with Derek Nighbor, Forest Products Association of Canada, 19 January 2022.
[55] CNN, 18 September 2021, US cities are losing 36 million trees a year. Here's why it matters and how you can stop it. https://www.cnn.com/2019/07/20/health/iyw-cities-losing-36-million-trees-how-to-help-trnd/index.html

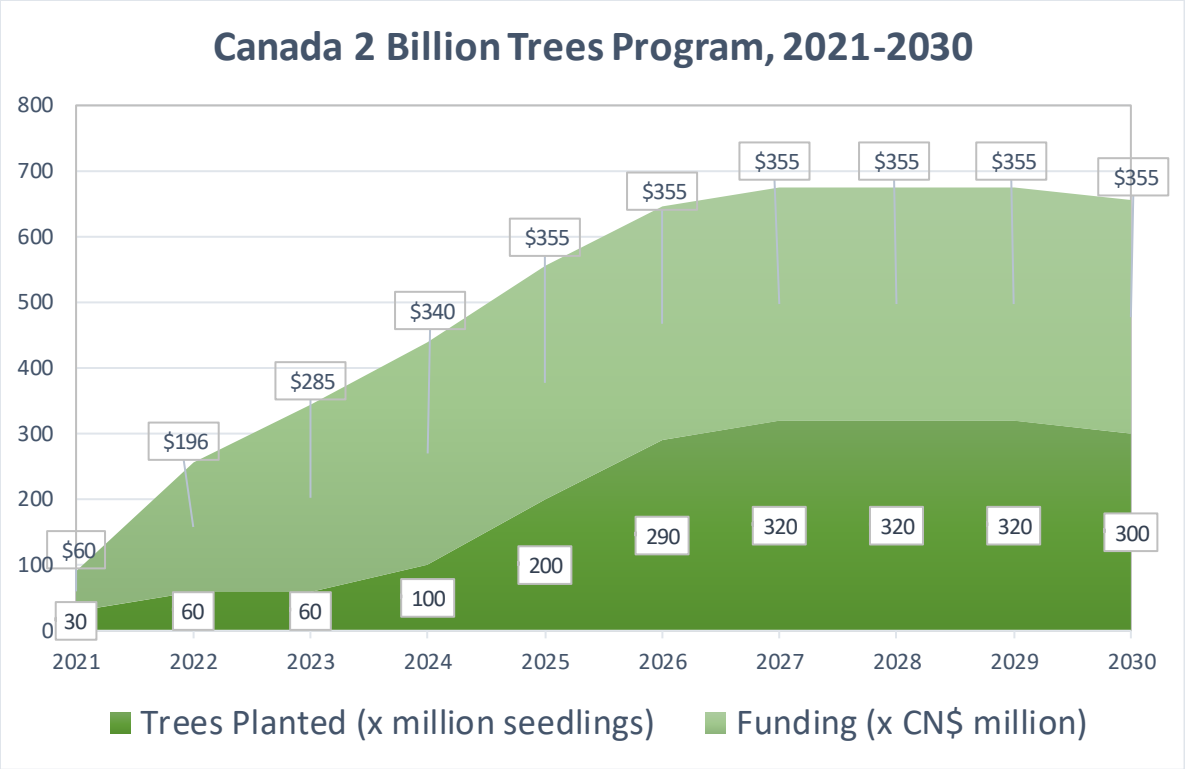


*Figure 3. The 2 Billion Trees Program of Natural Resources Canada.*

(Source: NRCan, 2021[56])

## Investing in forests and forest industry in recovery plans

Wood is a renewable resource and can be harvested sustainably and processed into materials with low embedded energy and high carbon content, substituting for other energy-intensive materials. The existing infrastructure can be upgraded to biorefineries producing high-value biomaterials and biochemicals (Fritsche *et al.*, 2021).

Fiscal policies could transition to zero carbon rather than supporting carbon intensive industries in the transport, energy, land use sectors. Investing in a sustainable recovery could be funded by pricing reforms including taxing carbon and removing fossil fuel subsidies[57]. Many estimates of the mitigation effect of low-carbon programs that focus on the energy sector ignore bioenergy, although combining forest biomass conversion with carbon capture and storage technology has great potential (Hanssen *et al.*, 2020). Further potential for carbon sequestration in the forest sector is being realized with the emergence of innovations such as

[56] NRCan, 2 Billion Trees update: Supply chain from seed to tree. https://www.canada.ca/en/campaign/2-billion-trees/2-billion-trees-update-supply-chain-from-seed-to-tree.html ; accessed 16 December 2021.
[57] World Economic Forum. Here's how to deliver a green recovery for the G20 economies. July 14, 2020. https://www.weforum.org/agenda/2020/07/rebuilding-green-g20-economies-after-covid-19/

mass timber construction and cross laminated timber[58]. Other innovations in packaging and containers, paper-based face masks, and utensils as discussed above are contributing to this transition. Advanced products can be manufactured from cellulose nanocrystals or filaments extracted from woody biomass (CCFM, 2017; Nasseri *et al.*, 2020)[59].

At the outset of the pandemic, the Forest Products Association of Canada proposed CN$ 1.5 billion in "shovel ready" projects for the recovery budget that focused on environmental improvements[60] in the forest products sector (CFPAC, 2020); many of these projects were funded[61]. The Government of Canada on 30 November 2020 released an economic statement that included funding for the forest sector [62]. In addition to the Billion Trees funding (above), an additional $C 30 million went to help small and medium-sized forest businesses to manage increased costs of safe operations, including tree-planting operations during the pandemic. In support of gender-centric provisions, the funding for commercial tree planting in 2020 and 2021 seeks to create opportunities for younger planters, as well as increased female representation. Beginning in 2021-22, $C 631million will be provided over ten years to restore degraded ecosystems, protect wildlife, and improve land and resource management practices. The provincial government of Alberta has deferred the payment of timber dues for up to six months[63] and the British Columbia government delayed imposing regulations on coastal log exports because of the market effects of the COVID-19 pandemic [64].

The Canada Emergency Wage Subsidy, the federal government's wage subsidy program, has provided limited benefit to the forestry sector[65] . Forestry ranked fourth last in terms of share of private sector workers covered by the subsidy. The governmental response has been

[58] Smart Cities, 4 November 2020, https://www.smartcitiesdive.com/news/mass-timber-reaches-for-new-heights-to-unlock-zero-carbon-cities/588354/

[59] Biomass. February 12, 2020. Resolute Forest Products to produce cellulose filaments in Quebec. http://biomassmagazine.com/articles/16806/resolute-forest-products-to-produce-cellulose-filaments-in-quebec#:~:text=Cellulose%20filaments%20are%20derived%20from,in%20a%20low%20carbon%20footprint.&text=that%20is%20dedicated%20to%20the%20development%20of%20nontraditional%20applications%20for%20cellulose%20filaments .

[60] Interview with Derek Nighbor, Forest Products Association of Canada, 28 October 2020.

[61] Interview with Derek Nighbor, Forest Products Association of Canada, 19 January 2022.

[62] "Supporting Canadians and Fighting Covid-19" https://www.budget.gc.ca/fes-eea/2020/report-rapport/toc-tdm-en.html

[63] Jo English, International Forest Industries. April 14, 2020. Forest Industry Commends Government for Dues Deferral. https://internationalforestindustries.com/2020/04/14/forest-industry-commends-government-dues-deferral/#:~:text=Edmonton%2C%20April%207%2C%202020%2C,for%20up%20to%20six%20months.&text=%E2%80%9CThis%20is%20not%20free%20money%20for%20the%20forest%20sector

[64] Victoria News June 11 2020, B.C. delays increase to log export restrictions inCOVID-19 crisis, https://www.vicnews.com/business/b-c-delays-increase-to-log-export-restrictions-in-covid-19-crisis/

[65] Interview with Derek Nighbor, FPAC. Nighbor said the association was frustrated that members were unable to access the wage subsidy program. He recommended that the program expanded to include individual mills and segments. There is no indication in the fiscal update that these recommendations were taken into consideration.

criticized for the rescue package containing a massive road expansion and tax relief for fossil fuel companies[66] .

In the USA, the Infrastructure Investment and Jobs Act (IIJA) provides new funding aimed at the forest sector (Table 2). It provides subsidies for sawmills and other wood processing facilities, along with US$400 million in new financial assistance. It specifies that agencies consider "close proximity" to a sawmill when funding federal land restoration. This provision addresses an existing challenge that existing wood processing infrastructure is too distant from many federal forests in desperate need of active management to be economically viable[67]. The legislation allocates US$2.1 billion to help manufacturers improve energy, water and material efficiency, load management and onsite generation to reduce waste and pollution while increasing profit. It includes a special set aside for small to medium sized manufacturing operations[36]. In one state, Maine, the governor announced a new Forestry Recovery Initiative that directs US$20 million of the federal funds to help forestry businesses financially recover from losses due to the pandemic and to develop new wood products, upgrade infrastructure to allow these businesses to expand, and to sell their products in new markets[68].

## International recovery efforts

The COVID-19 pandemic has brought to the forefront of international dialogue another factor, the loss of natural habitat and the rise of zoonoses (Everard *et al.*, 2020; Tollefson, 2020), the deforestation link[69]. Studies have pointed out that it is less expensive to prevent viral pandemics than fix them (Dobson *et al.*, 2020; Tollefson, 2020). Because the greatest threat of zoonoses is habitat loss in the tropics, one measure suggested is to swap the debt of developing countries, where debt is reduced so that capital can be redirected toward climate and biodiversity programs (Steele and Patel, 2020).

The USA supports international conservation efforts through foreign assistance programs funded by Congress via annual appropriations and implemented by multiple federal departments and agencies. The focus is on protecting species, restoring habitats, and recovering forests, among other things. Funding by the USA government for international conservation programs declined under the Trump administration, although not as much as was requested by the Administration (Congress appropriated funds above the Trump Administration's request for biodiversity funding for USAID In FY2019 and FY2020; in FY2021, Congress appropriated more than three times the Administration's request.) Funding has rebounded somewhat in FY 2021 and 2022 under the Biden administration (Figure 4).

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[66] The Guardian, November 2020, https://www.theguardian.com/environment/2020/nov/09/revealed-covid-recovery-plans-threaten-global-climate-hopes?utm_source=Nature+Briefing&ut%E2%80%A6

[67] Forest2market, 9 November 2021, House passes $1.2trillion infrastructure bill: What's in it for forestry? https://www.forest2market.com/blog/house-passes-1.2-trillion-infrastructure-bill-whats-in-it-for-forestry

[68] https://www.newscentermaine.com/article/money/gov-mills-announces-20-million-to-maines-forest-products-industry-workers/97-2790e8c0-a1c9-43b7-9144-4fd7688b00dc

[69] Interview with Maureen Whelan, Natural Resources Canada. October 30, 2020.

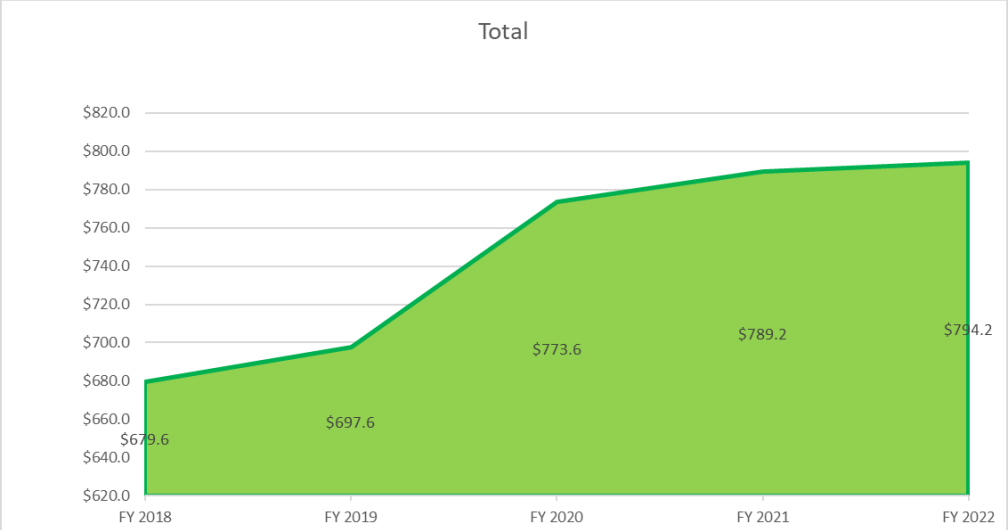


*Figure 4. Total USA federal appropriations for conservation programs, fiscal years (FY) 2018-2022*

(FY 2022 is the current presidential request, the appropriation bill has not passed). Source: (CRS, 2021)

The Administration budget request for FY2022 would reduce biodiversity funding and increase Sustainable Landscapes Program funding, which addresses deforestation and forest degradation (Table 3). Congressional legislation has been introduced directing interagency collaboration to identify zoonotic diseases and study factors that contribute to their emergence. One effort would have USAID and other federal agencies together implement programs aimed at reducing the risks of emerging infectious diseases. This effort would prevent degradation and fragmentation of ecosystems to conserve biodiversity, improve food security, and minimize the human-wildlife interface. While some policymakers favor an integrated, "whole-of-government" approach to international conservation assistance, others oppose holistic approaches, arguing that agency programs should be guided by their specific legislative authorities. Nevertheless, the outbreak of COVID-19 has stimulated discussion (CRS, 2021).

*Table 3. US government funding for international conservation programs, FY 2018-2022 in millions of US$*

(Source: (CRS, 2021)

| Agency/Program | FY 2018 | FT 2019 | FY 2020 | FY 2021 | FY 2022* |
|---|---|---|---|---|---|
| USAID Biodiversity | $269.0 | $285.0 | $315.0 | $320.0 | $217.1 |
| USAID Wildlife | $90.7 | $90.7 | $100.7 | $100.7 | $92.7 |
| USAID/State Sustainable Landscapes | $123.5 | $125.0 | $135.0 | $135.0 | $232.3 |

| | | | | | |
|---|---|---|---|---|---|
| State International Conservation | $7.0 | $7.0 | $7.0 | $7.0 | $7.0 |
| UNEP | $10.0 | $10.0 | $10.6 | $10.6 | $10.2 |
| GEF | $139.6 | $139.6 | $139.6 | $139.6 | $149.3 |
| Tropical Forest Conservation | $0.0 | $0.0 | $15.0 | $15.0 | $15.0 |
| FWS Multispecies Conservation | $11.1 | $11.6 | $15.0 | $18.0 | $18.0 |
| FWS Neotropical Migratory Bird | $3.9 | $3.9 | $4.9 | $4.9 | $7.9 |
| FWS International Affairs | $15.8 | $15.8 | $18.8 | $23.0 | $29.3 |
| USFS International Programs | $9.0 | $9.0 | $12.0 | $15.4 | $15.4 |

* FY2022 is the requested funding; the appropriations bill has not passed as of this writing.

The "One Health Approach" integrates care for people, species, and the planet, in addressing the global challenges of climate change, biodiversity loss and pandemics. In the USA, this effort is led by experts from CDC's One Health Office who conduct One Health Zoonotic Disease Prioritization (OHZDP) workshops in countries, regions, and other areas to help them prioritize their top zoonotic diseases of greatest concern[70]. The OHZDP process brings together representatives from human, animal, and environmental health sectors, as well as other relevant partners, to prioritize zoonotic diseases of greatest concern. In the USA, COVID-19 was added to other zoonotic diseases (zoonotic influenza, salmonellosis, West Nile virus, plague, rabies, brucellosis, and Lyme disease). A Joint External Evaluation in 2016 led to a collaboration among the CDC, USDA, and DOI agencies.

In USDA, the main actor is the APHIS Veterinary Services[71] who have confirmed 338 cases of COVID-19 in captive or pet animals, and 17 cases on mink farms. The main actors in DOI are the US Fish and Wildlife Service (USFWS) and the US Geological Service (USGS). The USFWS developed a SARS-CoV-2 vaccine to support conservation of the endangered black-footed ferret. Despite no evidence of SARS-CoV-2 has been found in captive or wild black-footed ferrets, it has been detected zoo animals farm workers have caught it from farm-raised mink (both are mustelids). Because of the importance of captive ferrets, most of the black-footed ferrets at USFWS National Black-footed Ferret Conservation Center were vaccinated as a precautionary measure.

[70] CDC One Health Office; https://www.cdc.gov/onehealth/what-we-do/zoonotic-disease-prioritization/index.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fonehealth%2Fglobal-activities%2Fprioritization.html

[71] Veterinary Services, APHIS (Animal Plant Health Inspection Service); https://www.aphis.usda.gov/aphis/dashboards/tableau/sars-dashboard

Bats are another wild animal of concern, which have been suspected as the animal reservoir of SARS-COV-2. The USGS examined the susceptibility of North American bats to SARS-CoV-2 and the likelihood of transmission to scientists or wildlife managers. If protective measures are taken, risk is very low (one in 1,000 personnel are likely to become infected during fieldwork). Infection trials in big brown bats found them resistant to infection but the reservoir potential of Mexican free-tailed bats is currently unknown and is under study[72].

Canadian involvement in the One Health Approach has a similar long history. The Canadian Community for Emerging and Zoonotic Diseases (CEZD) is a virtual network that includes representatives from federal, provincial, and municipal governments, academia and the private sector who have an expertise in public, animal, and environmental health[73]. The CEZD core team is based within the Canadian Food Inspection Agency. The CEZD gathers information on emerging and zoonotic diseases and shares early detections and warnings. CEZD uses an automated information mining tool, called KIWI (Knowledge Integration) that collects and filters information from open and online sources related to emerging and zoonotic diseases. KIWI was developed by the Canadian Network for Public Health Intelligence within the National Microbiology Laboratory of the Public Health Agency of Canada.

## Opportunities to strengthen institutions and policies

A proactive approach is needed to position GI as "critical infrastructure". An enabling environment of supportive legislative framework is needed at multiple scales, from national to local levels. Recovery funding directed at infrastructure should require GI in all new construction, with costs borne by developers. To achieve equity in disbursing public monies, legislation is needed that explicitly requires the delivery of GI in low-income, high-density, and ethnically diverse areas. Community-led planning is needed to ensure that developments are accessible, meaningful, and functional for local populations (Mell and Whitten, 2021). Directing stimulus and recovery spending toward infrastructure that supports a more progressive future than a return to business as usual (Stark, 2020) focuses on "Green Infrastructure" (GI). The green sector was one of the few bright spots in the global economy after the 2008 financial crisis (Zenghelis, 2014), with similarities to the current condition. This seems to be the approach of the Canadian government[74]. Nevertheless, there is an opposing view that says that these policies might yield long-term climate benefits but at the expense of a slower and smaller recovery than a traditional macroeconomic stimulus directed at industries with high unemployment (Brahmbhatt, 2021).

Labor shortages and supply chain disruption associated with the COVID pandemic sparked thinking about short- and long-term recovery measures. The importance of the rapid and aggressive government response was recognized (Kline *et al.*, 2021). Recommendations for

[72] US Geological Survey; https://www.usgs.gov/mission-areas/ecosystems/news/usgs-one-health-approach-wildlife-disease-and-environmental-change
[73] CZED; https://inspection.canada.ca/science-and-research/sciencecollaborations/cezd/eng/1573850654930/1573850655445
[74] Interview with Maureen Whelan, Natural Resources Canada (UNFF Point of Contact), October 30, 2020.

addressing the labor and supply chain problems included training for skilled trades workers such as mill operation and maintenance, forest road planning, construction, and prescribed burners (Kline *et al.*, 2021). Some companies are already seeking to increase logistics and trucking services by contracting out, as noted above. The IIJA addressed the perceived truck driver shortage through a pilot program to allow young drivers (between 18-21 years old) to operate trucks interstate after completing rigorous operational and safety training. Related language seeks to increase diversity by promoting more women truckers. Increasing training at all levels of the transportation workforce seeks, among other goals, to meet the current and future shortage of drivers[75,76]. Some argue, however, that the problem is low wages and de-regulation of the trucking industry introduced structural limitations disfavoring drivers[77].

Pandemic-related problems are due to the high rate of absenteeism due to isolation/quarantine requirement for those with COVID[78]. There is a truck driver shortage in Canada as well, partly due to the vaccine mandate at the border. All in all, there is a need for an expanded temporary foreign worker program. Supply chain performance is the big problem now for the forest industry in Canada[79]. Shipping containers are in short supply because of the pandemic. In Canada, especially in rural areas, the problem is rail transportation has become unreliable and not just because of weather (snowfall and flooding). Many mills are in remote locations with a single rail line access. Some mills in Western Canada have closed because they have run out of warehouse space to store production. There will be a national supply chain summit on 31 January.

## Efforts to strengthen data collection, analysis, and exchange

The Canadian government has proposed to mandate the use of Traditional Ecological Knowledge (TEK) in environmental statutes and treaty provisions. First Nations, Inuit, and Metís have a voice in environmental decision making impacting the land and resources that they have inhabited, utilized, and managed for generations[80]. This is apparent in the requirement to "consult" indigenous communities, in co-management agreements, and especially in management of protected areas. In 2015, Parks Canada adopted the "PARKS" guiding principles

[75] Forest2market, 9 November 2021, House passes $1.2trillion infrastructure bill: What's in it for forestry? https://www.forest2market.com/blog/house-passes-1.2-trillion-infrastructure-bill-whats-in-it-for-forestry

[76] Quartz 19 January 2022, Unvaccinated truckers are making Canada's vegetable shortage worse; https://qz.com/2114819/unvaccinated-truckers-are-worsening-canadas-vegetable-shortage/?utm_source=email&utm_medium=daily-brief&utm_content=56c6bfe7-79d6-11ec-b3f8-823fa429890e

[77] Smart Trucking, 14 October 2021, the truck driver shortage – the dirty truth no one talks about; https://www.smart-trucking.com/truck-driver-shortage/

[78] Washington Post 20 January 2022, Workers are out sick in record numbers, exacerbating labor shortage woes; https://www.washingtonpost.com/business/2022/01/20/workers-out-sick-omicron-census/

[79] Interview with Derek Nighbor, Forest Products Association of Canada, 19 January 2022.

[80] Harris, CR, Environmental Law Institute, 12 December 2018,Traditional Ecological Knowledge and the Law: The Canadian Case (Part II); https://www.eli.org/vibrant-environment-blog/traditional-ecological-knowledge-and-law-canadian-case-part-ii

to provide a consistent approach for Indigenous engagement and relationship building across the heritage places administered by Parks Canada[81]. The PARKS guiding principles are:

- Partnership: Working collaboratively in heritage place planning, management, and operations
- Accessible: Encouraging access to traditional lands and traditional activities
- Respectful: Building mutual respect, trust and understanding
- Knowledge-based: Honoring and incorporating traditional knowledge
- Supportive: Supporting Indigenous partners' community interests

Canada has designated Indigenous Protected and Conserved Areas (IPCAs) with the same protection as a National Wildlife Area. The hope is that these IPCAs will help meet Canada's biodiversity Aichi Goals and Targets. In 2018, Canada and the Dehcho K'éhodi designated Edéhzhíe, Canada's first Indigenous Protected Area, which will be managed by a board comprised of federal and indigenous members. Edéhzhíe is 14,000 square miles of mineral-rich land, home to boreal forests and species at risk[67].

Data are important but the Canadian government is not investing data collection and analysis to the extent needed[82]. Government tends to rely on companies for data on forests. Canada has a world-renowned carbon modeling system (Kurz *et al*., 2009) but lacking in for example extensive data on soil carbon processes.

The USA government has taken steps to give more weight to Indigenous Traditional Ecological Knowledge (ITEK) in federal scientific and policy processes. A recent memorandum by the White House Office of Science and Technology Policy and the White House Council on Environmental Quality commits to improving Federal engagement with Tribal Nations and Native communities around ITEK. Specific steps taken were standing up an Interagency Working Group on Indigenous Traditional Ecological Knowledge. An earlier executive order directed federal agencies to develop plans for ensuring meaningful Tribal consultation on agency work that may affect Tribal Nations[83].

The pandemic immediately challenged traditional ways of data collection based on field challenged due to travel restrictions with long-term uncertainty as to when it would be safe to return to business as usual. To date, most USFS employees are working remotely or in hybrid arrangements[84]. A new collaboration between forest health specialists who conduct the annual Aerial Detection Survey (ADS) program and other remote sensing specialists from the Forest Service and academia developed ways to overcome these constraints (Hanavan *et al.*, 2021).

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[81] Parks Canada, Indigenous relations at Parks Canada; https://www.pc.gc.ca/en/agence-agency/aa-ia/parcours-pathways

[82] Interview with Derek Nighbor, Forest Products Association of Canada, 19 January 2022.

[83] White House, 15 November 2021, White House Commits to Elevating Indigenous Knowledge in Federal Policy Decisions; https://www.whitehouse.gov/ceq/news-updates/2021/11/15/white-house-commits-to-elevating-indigenous-knowledge-in-federal-policy-decisions/

[84] Interviews with Drs. Mac Callaham and Yongqiang Liu, Southern Research Station, 11 January 2020.

Small ad hoc teams identified regional program resources to enhance use of remote sensing and provided supplemental information where aerial detection surveys were ineffective. This collaboration optimized a combination of ADS, remote sensing, and field visits to deliver a comprehensive, robust, and near-real-time assessment of forest health.

Although the pandemic cancelled or delayed forest research and management activities (Stanturf and Mansuy, 2021), the pause also offered opportunities for stock-taking and catching up (Miller-Rushing *et al.*, 2021). For example, the US National Park Service Inventory and Monitoring Division postponed their 2020 fieldwork in favor of using the funds saved to increase staffing for 2021 fieldwork. They decided that reduced sampling intensity would limit the usefulness of the data to detect temporal trends and would put field staff at risk (Miller-Rushing *et al.*, 2021). Instead, they adjusted existing studies and started new one to examine the impacts of the pandemic on visitation patterns, wildlife behavior, and air quality. The "down time" was an opportunity to address the backlog on data analyses and syntheses. The closures and other limitations on visitation allowed researchers to examine the public's response to new approaches address overcrowding during peak park visitation times, measures that have been unpopular. Managers were also able to work with local governments surrounding communities to improve responses to rapid changes and emergencies (Jacobs *et al.*, 2020).

## Best Practices for Reducing the Impact of COVID-19 on Forests and the Forest Sector

The US Forest Service is attempting to return employees to on-site work[85]. In the meantime, it is offering maximum telework flexibilities, consistent with operational needs. All on-duty or on-site employees and contractors are required to wear face masks and maintain physical distance. Employees are provided appropriate PPE when requested. Anyone coming into USDA buildings for any reason are required to follow the same masking and physical distancing rules; this includes masking in outdoor shared spaces and USDA vehicles when physical distancing cannot be maintained. Signs are posted at doors, reception desks, and commons areas such as restrooms and hallways, conference rooms, and ranger district stations. Non-compliant customers and visitors are directed to depart the premises and conduct business off-site (over the phone or online)[86]. Federal employees and contractors are mandated to be vaccinated or be terminated from employment, with a few exemptions for health or religious reasons; court

[85] USDA Workplace Safety Plan; http://www.usda.gov/coronavirus/workplacesafetyplan
[86] Executive Order Protecting the Federal Workforce and Requiring Mask Wearing, 20 January 2021; https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-the-federal-workforce-and-requiring-mask-wearing/

challenges have stayed application to federal contractors[87]. Application to businesses with more than 100 employees has been stayed by the Supreme Court[88].

Considering the pandemic's high unemployment and loss of businesses, nations, and regions overdependent on tourism as a primary economic driver are rethinking their economic development strategies (Bates *et al.*, 2021). For example, in Hawai'i the pandemic caused a steep decline in visitors, revealing significant impacts on natural resources. Once tourism resumed, visitor limitations were imposed (Agrusa *et al.*, 2021).

Park managers adopted strategies to ensure safer visitation, such as timed entry, signage for social distancing, guidelines for responsible recreation and increased infrastructure cleaning (Spenceley *et al.*, 2021). Outfitters and tour guides have adopted protocols[89,90] that enabled a return to almost normal operation in 2021. Many National Parks and National Forests in the USA have gone to reservations only visitation[91] . The National Park Service has a Trip Planning Guide, "Find a Park"[92], and a new NPS App[93], which consolidates all 423 park units in one mobile tool. For National Forests and other public attractions, reservations can be made at "Tickets & Tours" or "Permits" on recreation.gov.

Forest tree nursery workers were deemed essential and USA State and Canadian Provincial authorities required nurseries to implement protocols to minimize the spread of the virus (Table 4). Nurseries made changes to their operations to limit contact and planned for contingencies should their facilities experience outbreaks (Nelson *et al.*, 2021). Short-term impacts included on added costs and decreased efficiencies, but long-term the practices implemented should enhance resiliency and enable the nurseries to attempt to meet increased demand (Fargione *et al.*, 2021).

The COVID-19 pandemic impacted forest-related post-secondary education that relies heavily on field experiences (Aubry *et al.*, 2021; Dodson and Blinn, 2021; Mahler *et al.*, 2021). Educators had to change their teaching modes quickly as colleges and universities moved to

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[87] Federal News Network, 10 January 2022, What exactly is today's status of the vaccine mandate in the federal space? https://federalnewsnetwork.com/workforce/2022/01/what-exactly-is-todays-status-of-the-vaccine-mandate-in-the-federal-space/

[88] CNN, 13 January 2022, Supreme Court blocks nationwide vaccine and testing mandate for large businesses, allows health care worker vaccine mandate to take effect; https://www.cnn.com/2022/01/13/politics/supreme-court-vaccine-mandate-covid-19/index.html

[89] America Outdoors Coronavirus resources; https://www.americaoutdoors.org/coronavirus-impacts-on-outdoor-travel/?CategoryId=25

[90] OARS COVID Mitigation plan, https://www.oars.com/wp-content/uploads/2020/06/OARS-COVID-19-GMP.pdf

[91] Washington Post 14 January 2022, National parks and forests bring back reservation systems to control crowds; https://www.washingtonpost.com/travel/2022/01/06/reservations-national-parks-forests/?utm_campaign=wp_by_the_way&utm_medium=email&utm_source=newsletter&wpisrc=nl_bytheway&carta-url=https%3A%2F%2Fs2.washingtonpost.com%2Fcar-ln-tr%2F35bda97%2F61e076c59d2fda14d7eefa5c%2F59788e56ae7e8a6816ea7b3a%2F14%2F37%2F61e076c59d2fda14d7eefa5c

[92] Find A Park; https://www.nps.gov/subjects/healthandsafety/trip-planning-guide.htm

[93] NPS App; https://www.nps.gov/subjects/digital/nps-apps.htm

remote teaching. Courses that had never been offered on-line were converted, mostly by moving content on-line without utilizing remote learning technology. Instructors and students were understandably stressed and overworked (Mahler *et al.*, 2021). Work-life balance suffered; assistant professors, females, caregivers of children and teenagers, and those who did not have access to a private workspace were significantly more affected (Aubry *et al.*, 2021). As institutions attempted return to in-class instruction, some universities required freshman courses to be taught in person by faculty who did not feel safe doing so (Aubry *et al.*, 2021).

There is some evidence that remote-learning produced lower-quality educational experiences. For example, forest operations courses rely heavily on field experiences and decreased field time and personal interaction among faculty and students reduced professional preparation of graduates during the pandemic. Employers may need to provide recently graduated employees

*Table 4. Risk assessment and protocols adopted by tree nurseries in the USA to minimize spread of COVID-19 and protect essential workers.*

Although some surface sanitation requirements may be unnecessary for COVID-19, they are effective against other illnesses. Source: (Nelson et al., 2021)

| **Activity** | **Level of Risk** | **Control Protocols** |
|---|---|---|
| Management | Low | • Implement safety policies<br>• Encourage safe practices outside of work<br>• Consider contract workers instead of temporary workers<br>• Establish work groups (pods)<br>• Stagger work schedules<br>• Conduct daily wellness checks<br>• Inspect sanitation stations frequently<br>• Paperless timekeeping<br>• Document safety and wellness checks<br>• Signage on all buildings for hygiene and distancing |
| Office Administration | Low | • Telework as possible<br>• Social distancing<br>• Wear PPE<br>• Plexiglass barriers between workstations and at front desk<br>• Sanitize commonly touched surfaces |
| Weeding/Thinning | Low | • Social distancing<br>• Sanitize tools after use<br>• Assign tools to individuals<br>• Provide disinfectant at all job sites<br>• Provide PPE |
| Growing and culturing | Low | • Social distancing<br>• Provide PPE |

| | | |
|---|---|---|
| | | • Sanitize surfaces after each use |
| Deliveries | Low/Moderate | • Drop-off and pick-up parcels outside<br>• Eliminate need for signatures or disinfect pens between uses<br>• Physical distancing when loading a truck<br>• Provide PPE |
| Sowing | Moderate | • Social distancing<br>• Install hanging screens between individuals<br>• Provide disinfectant at all job sites<br>• Sanitize workstations between shifts<br>• Provide PPE<br>• Slow equipment speed to accommodate lower staffing |
| Lifting/Grading | Moderate | • Install hanging screens between individuals<br>• Use turntable stations<br>• Provide disinfectant at each station<br>• Disinfect equipment between shifts<br>• Provide PPE<br>• Slow equipment speed to accommodate lower staffing |
| First Aid | High | • Designate a first aid attendant<br>• Wear PPE while treating<br>• Conduct evaluations/treatments outdoors when possible |

with additional training in field methods and application of concepts to real-world situations (Dodson and Blinn, 2021). Nevertheless, the experience during the pandemic could have a positive influence on post-secondary instruction in the future as instructors may have expanded their digital skills, resources, and teaching methods (Dodson and Blinn, 2021).

Travel restrictions and lockdowns have motivated scientists used to traveling to countries to collect specimens and data to change to virtual meetings to connect with local experts to achieve research goals. Scientists have needed to depend on local scientists and community experts to conduct field operations. For example, researchers from Dalhousie and Memorial Universities in Atlantic Canada partnered with the Nunatsiavut Government to co-develop and co-lead a research project (Bates *et al.*, 2021). Creating a network of local positions has been recognized as invaluable for the success and co-development of the project, recognizing that local research teams have locally relevant local knowledge and field expertise, with the skills to lead and conduct research in partnerships with non-local scientists.

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