Research Program Annual Report

FISCAL YEAR 2022–2023

BRITISH COLUMBIA | Ministry of Forests

Contents

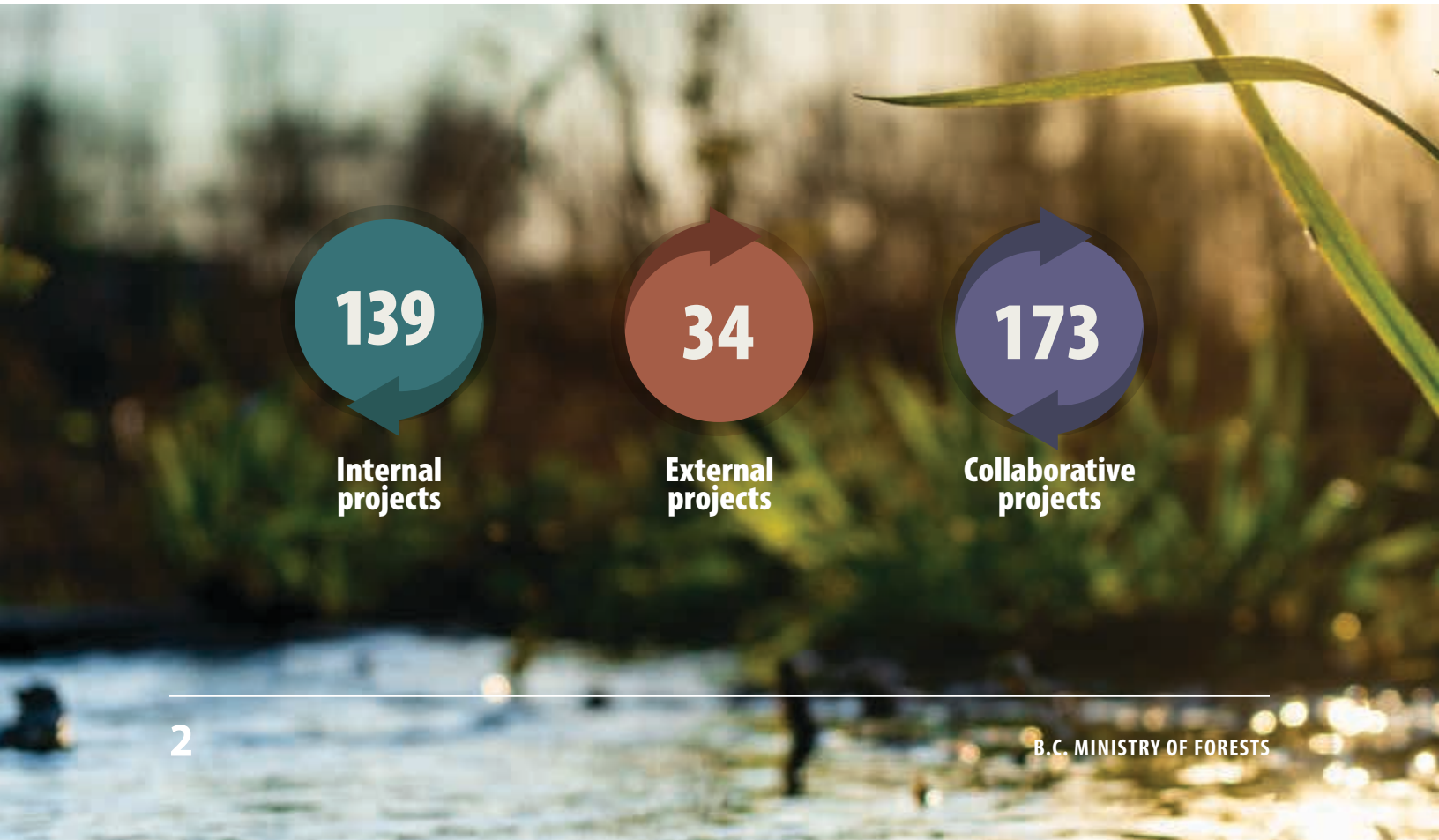
Executive Summary

In 2022–2023, the Ministry of Forests Research Program produced scientific knowledge to help operations, decision makers, and the public at large. This year, the Research Program underwent a series of transitions; however, the program remains well placed to support the successful management of British Columbia's natural resources. The program offers expert scientific information on multiple values: biodiversity, climate, carbon sequestration, ecology, ecosystem services, forest health, species habitat including endangered or protected species, soils, and watersheds.

The Research Program funded 139 projects, with another 34 collaborative projects funded externally. Program researchers investigated climate change, forest health, wildfires, and drought, to name a few key topics. The Research Program is guided by its Strategic Plan 2021–2024, which defines its vision, values, governance, and strategic goals. On an annual basis, the program's research priorities are updated with input from key stakeholders.

Researchers actively collaborate and partner with academia; non-governmental organizations; First Nations; municipal, provincial, and federal governments; and industry. These ongoing collaborations are essential to the Research Program's ability to support the Ministry in its commitment to reconciliation, as well as its world-renowned stewardship and natural resource management. An important area of collaboration is with the new Forest Landscape Plans, which are set to replace Forest Stewardship Plans. The Research Program also supports the ongoing work related to the Old Growth Strategy and wildfire impacts.

As in years past, the Research Program continued its work supporting British Columbia's natural resource sector and the public by sharing its research findings annually with these reports.



Introduction

The 2022–2023 fiscal year presented a number of shifts for the Ministry of Forests Research Program. The program has undergone a year of renewal, with researcher retirements and the hiring and onboarding of new team members. The Research Program continues to work toward its vision of supporting the Ministry's decisions through rigorous science, and works to provide innovative solutions to natural resource sector challenges in British Columbia through research, data, and extension.

As guided by its Strategic Plan 2021–2024, the Research Program works toward three main goals: maintaining excellence in applied research; sustaining an effective and proactive research culture; and reinforcing research knowledge management and extension services. These goals are integral to supporting the Ministry's complex resource management decisions and policies.

The Research Program has six research portfolios: Ecosystem Stewardship; Ecosystem Health and Disturbance; Water; Species and Habitats; Timber Supply; and Bio-Economy. Each portfolio is led by an interdisciplinary team of research scientists, representing regional and provincial research interests to optimize research investments and scientific results. Understanding projected climate change impacts is integral to all six portfolios.

This annual report outlines how the Research Program worked toward its goals in the 2022–2023 fiscal year, from April 1, 2022, to March 31, 2023. It includes the focus of each research portfolio, with information on research project highlights and relevant publications. It also describes collaborative projects, including First Nations collaborations, old growth forest research, and wildfire research.

Research Program Overview

The Research Program has more than 70 research scientists, auxiliary personnel, and technicians. These expert staff plan and conduct research throughout British Columbia (Figure 1) and collaborate with co-op and graduate students to fulfill research portfolio goals. Their interdisciplinary expertise drives the program's research excellence.

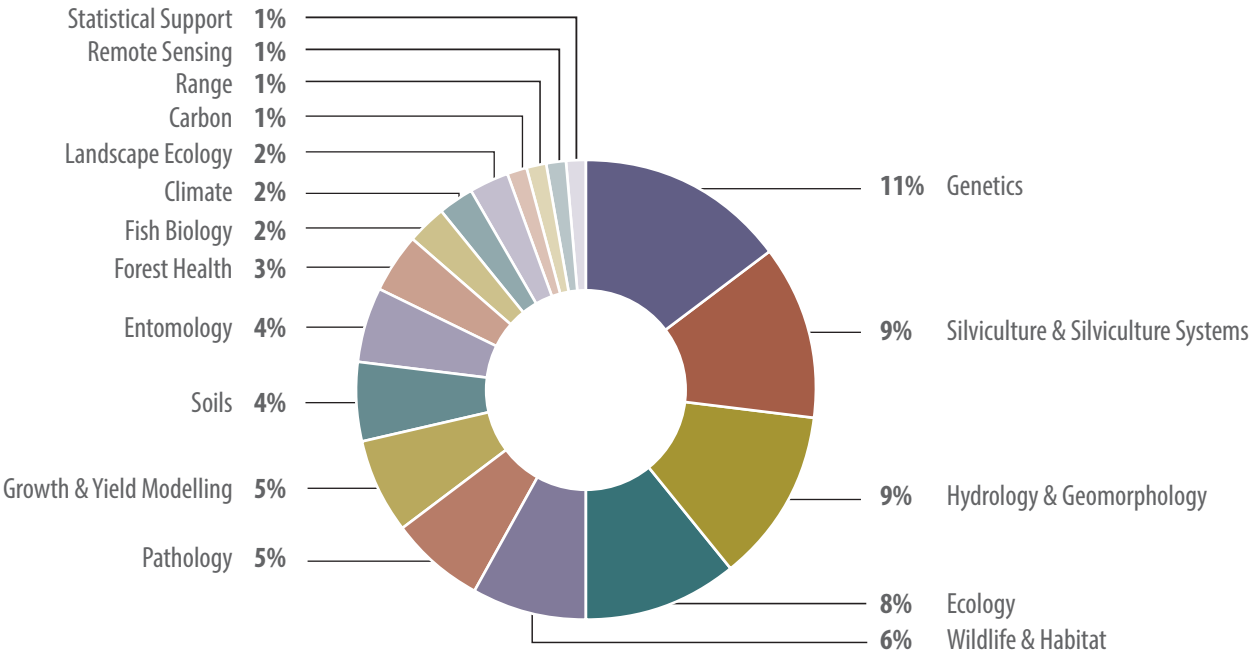


Figure 1. Areas of expertise of Ministry of Forests research scientists.

During the 2022–2023 fiscal year, Ministry scientists delivered 139 projects funded through the Research Program, plus 34 projects funded outside the program, for a total of 173 projects. Many of the Research Program projects span multiple forest districts and regions; the geographical locations of principal investigators are indicated in Figure 2. The 34 externally funded projects were assigned to principal investigators in Victoria (16), the north (9), the coast (3), and the south (6).

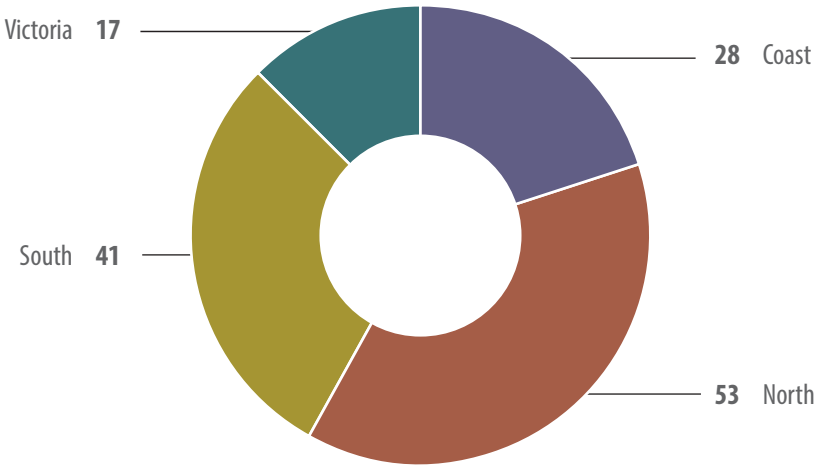


Figure 2. Number of projects conducted, by geographical location of the principal investigator, during the 2022-2023 fiscal year.

Research Program members actively collaborate with municipal, provincial, and federal governments and agencies, First Nations, and academic institutions from across Canada and the United States, as well as with national and international research organizations, the forest industry, and non-profit organizations (Table 1).

Table 1. Research Collaborations and Partnerships

Provincial	Alberta Environment and Parks; BC Timber Sales; BC Wildfire Service; Indigenous Skills and Employment Training Program; Ministry of Environment and Climate Change Strategy; Ministry of Forests; Ministry of Water, Land and Resource Stewardship; Ministry of Transportation and Infrastructure
Municipal	Comox Valley Regional District; Metro Vancouver; Regional District of Nanaimo
Federal	Canadian Forest Service; Geological Survey of Canada; Parks Canada
Academic Institutions	College of New Caledonia; Kwantlen Polytechnic University; Michigan Tech University; Simon Fraser University; Thompson Rivers University; University of Alberta; University of British Columbia; University of British Columbia Okanagan; University of Idaho; University of Northern British Columbia; University of Victoria; University of Western Ontario; Vancouver Island University; Wilfrid Laurier University
Non-governmental Institutions and Organizations	Aleza Lake Research Forest; BC Conservation Foundation; B.C. First Nations Forestry Council; B.C. Wildlife Federation; Bulkley Valley Research Centre; Canada Wildfire; Canadian Interagency Forest Fire Centre; Columbia Basin Trust; Forest Enhancement Society of British Columbia; Friends of Kootenay Lake Stewardship Society; Habitat Conservation Trust Fund; Hakai Institute; John Prince Research Forest; Nature Conservancy of Canada; Nechako White Sturgeon Recovery Initiative; Pacific Salmon Foundation; San Juan Roundtable; Wells Community Forest; Western Association of Fish and Wildlife Agencies
First Nations	Coast Tsimshian Resources; Gitanyow First Nation; Gitga'at First Nation; Gitxsan First Nation; Homalco First Nation; Líl̓wat First Nation; Nanwakolas Council; Okanagan Nation Alliance; Pacheedaht First Nation; shíshálh Nation; Tāłtān First Nation; Taku River Tlingit First Nation; Tsay Keh Dene First Nation; Xeni Gwet'in First Nation
Industry and Private Sector	Brinkman Forest Ltd.; Cordilleran Geoscience; Ecora Engineering and Resources Group; ESSA Technologies Ltd.; FREP Wildlife Value; Kitselas Forest Products; Mosaic Forest Management; Northwest Timberlands; Pacific Climate Impacts Consortium; Research Corporation; Skeena Forestry Consultants; Slocan Integral Forestry Cooperative; Statlu Environmental Consulting; Teck; Tolko Industries; West Fraser Timber; Wildlife Dynamics Consulting; Western Forest Products
International	U.S. Geological Survey; University of Melbourne; USDA Forest Service; International Statistics

Research Program Achievements in 2022–2023

The Research Program's goals focus on maintaining high-quality research and science and managing information and knowledge to support decision- and policy-makers.

Goal 1

MAINTAIN EXCELLENCE IN APPLIED RESEARCH

The Research Program endeavours to be a trusted provider of scientific information to support sustainable resource management decisions and policy development. For the 2022–2023 fiscal year the Research Program:

- Refined and applied its business cycle, including planning for and development, submission, and review of proposals to ensure research alignment with Ministry needs and priorities.
- Implemented the Terms of Reference of the Research Oversight Committee.

Goal 2

SUSTAIN AN EFFECTIVE AND PROACTIVE RESEARCH CULTURE

To ensure delivery by expert, experienced, and respected research professionals, in 2022–2023 the Research Program:

- Held monthly Research Oversight Committee meetings and provided regular updates to the Executive.
- Held monthly Research Leadership Committee meetings, which provide feedback to the Research Program from field operations and a floor for Team Leads to discuss management issues.
- Held monthly Provincial Research feedback meetings to allow researchers across the province to communicate research progress and field operations, as well as stay up to date on research events, staffing, and achievements.
- Continued to implement the **Research Program Strategic Plan for 2021–2024**.
- Continued to identify and build partnership opportunities with other agencies (e.g., universities, Canadian Forest Service, Bulkley Valley Research Centre) to leverage expertise, conduct science to inform and improve forest management practices, and address issues of mutual interest and benefit.
- Implemented an auditable, electronic submission process for the registration and update of research installations on the land base.

Goal 3

REINFORCE RESEARCH KNOWLEDGE MANAGEMENT AND EXTENSION SERVICES

To ensure a strong presence both inside and outside the Ministry, the following actions were taken in the 2022–2023 fiscal year:

- Held a three-day research symposium, in conjunction with the University of Northern British Columbia in Prince George, with over 100 attendees
  - Conducted field trips as part of the symposium, including to Aleza Lake Research Forest and John Prince Research Forest, with a co-developed agenda that emphasized collaborations between Ministry researchers and academics to foster working relationships and build upon existing collaborations.
  - Received highly positive survey feedback on the symposium, with 89% of respondents showing a preference for the mixed format of the symposium (lecture sessions and field trips) and 84% feeling the presentations were well-targeted.
- Produced outreach and communication materials to increase awareness of the Research Program, including:
  - Association of BC Forest Professionals (ABCFP) magazine, Fall 2022 issue: *Declining Forests and a Forgotten Bark Beetle*, by Lorraine Maclauchlan, PhD, RPF, RPBio; Celia Boone, PhD, P.Ag; and Jeanne Robert, PhD, RPBio.
  - BC Forest Professionals webinar: *Biogeoclimatic Zone Updates (South Interior)*, by Deb MacKillop, RPF, and Kristi Iverson, RPBio.
- Attended the 2022 First Nations Forestry Council Annual Conference, with the Research management team representing the program and its commitment to listen to and foster working relationships and research with First Nations partners.
- Wrapped up the second half of season one of the "**Forest of Ideas**" podcast, in which researchers were invited to share their experiences as government scientists on a wide variety of topics. The show is hosted by Research Lead for Silviculture Jodi Axelson and Senior Timber Tenures Forester Steve Baumber. The season culminated with an interview with Chief Forester Shane Berg.
- Submitted regular updates by research area to the Ministry of Forests internal newsletter, "The Understory."
- Revamped and updated **publicly accessible web pages** with information about the Research Program, including an up-to-date list of publications organized by author and expertise. Information about key research projects and staff achievements continues to be updated.
- Completed an overhaul of the research projects installation software and database, improving research installation data integrity, data security, and overall usability for Ministry of Forests staff, strengthening the Ministry's internal research knowledge management.

Research Portfolios and 2022–2023 Research Examples

The Ministry of Forests Research Program is organized into six research portfolios: Ecosystem Stewardship, Ecosystem Health and Disturbance, Water, Species and Habitats, Timber Supply, and Bio-Economy. During the 2022–2023 fiscal year, researchers conducted 173 projects under these research portfolios (Figure 3), and published their findings in peer-reviewed journals, field guides, and/or technical reports. They also presented at area-of-expertise workshops and conferences and co-supervised graduate students at a variety of institutions, collaborating with them on their research.

Each research portfolio has strategic priorities is led by an interdisciplinary team that represents regional- and provincial-level research needs. The following pages highlight a selection of each team's research achievements.

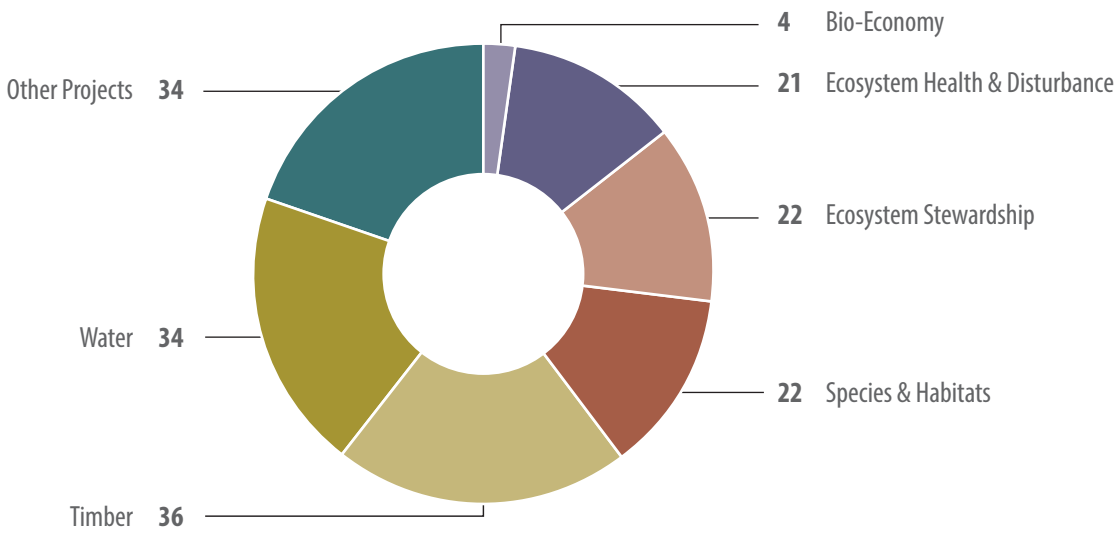


Figure 3. Number of research projects by research portfolio underway in fiscal year 2022-2023.

ECOSYSTEM STEWARDSHIP

Helping maintain healthy and resilient forests

In the face of increasing climate and socio-ecological uncertainty, the Ecosystem Stewardship Research Portfolio supports management decisions that maintain or enhance ecosystem services. Research themes include determining the vulnerability of ecosystems to resource development and climate change, fostering ecosystem resilience, and building adaptive capacity. The following are highlights from the Ecosystem Stewardship Research Portfolio in the 2022–2023 fiscal year.

Biogeoclimatic Ecosystem Classification (BEC) Updates

The BEC system has been used to improve resource management in British Columbia since 1975. It is the cornerstone of many stewardship and inventory decision-making processes, including tree species selection, stocking standards, timber supply reviews, and cumulative effects assessments. It supports habitat and forage mapping that is important to wildlife and range management, species distribution predictions, and high-resolution ecosystem map production.

Ongoing updates to the BEC system include extensive field sampling for site-level classification and description, landscape-level biogeoclimatic mapping, and improvements to soils and terrain information as well as provincial standards for ecosystem data collection. In 2022–2023, researchers published A Field Guide to Ecosystem Classification and Identification for the Southern Thompson–Okanagan, with revised mapping and classification for parts of the North Thompson and draft mapping and classification for parts of the Kootenay-Boundary Region, the South Coast Region, Vancouver Island, and the Great Bear Rainforest. Research staff also conducted field sampling in the Vancouver Island floodplains and in northern units of the Skeena Region in collaboration with the Tāłtān and Taku River Tlingit First Nations.

Climate Change Monitoring, Modelling, and Analysis

Researchers worked to integrate climate change information into operational resource management and decision-making such as adaptive silviculture, timber supply modelling, annual allowable cut determinations, and landscape resiliency projects. Work continued in 2022–2023 on a web-based application to support integrating climate change into Forest Landscape Planning by modelling the historical and future range of variability in landscape metrics including patch size, area, and connectedness. As climate change increases the frequency of disturbance, researchers are also working to understand ecosystem recovery, such as how to restore post-wildfire Old Growth Management Areas with climate change–informed experimental tree planting.

British Columbia Soils

Soils research supports the incorporation of soil information in understanding disturbance effects, efficacy of silviculture treatments, inherent constraints on stand productivity, and long-term effects on carbon sequestration. This work includes contributing to a province-wide Long-Term Soil Productivity study, now more than 20 years post-treatment. In 2022–2023, researchers made significant progress on mapping soil parent materials in the Robson Valley in partnership with the Geological Survey of Canada. The results are published as an accessible landslide inventory for the area. Researchers also continued examining grassland–forest transition zones. Both projects include important soil carbon characterization.

The soils program is evaluating the extent of local adaptation between populations of coastal Douglas-fir and their symbiotic fungi (ectomycorrhiza, or EMF). A fundamental edaphic difference in the region is the extent of soil podzolization, resulting in steep declines in available phosphorus (P), an essential element for tree growth. As a consequence, EMF species found in these heavily weathered soils can use enzymes to access P from organic matter. In a comparison of ten Douglas-fir seedlots grown in contrasting soils, it was reported that EMF communities were much more variable on a low-P soil. This response may be owing to the host and fungi's local genetic adaptations to soil P deficiencies. Improving our understanding of EMF community linkages to host genetics is critical for the success of climate change–assisted migration strategies that now form the scientific basis of reforestation policy in British Columbia.

Forest and Landscape Dynamics

Applied research aimed at answering management questions is key to ensuring sound environmental stewardship. For example, multiple techniques have been explored to understand and predict the presence of culturally important plants, as defined by First Nations partners and through legislation like the Great Bear Rainforest Land Use Order. Visualization tools have been developed to improve the integration of this culturally important information into wider land-use planning. Research is being carried out in collaboration with the shíshálh Nation on the Sunshine Coast, the Nanwakolas Council member Nations in the Great Bear Rainforest, and academic partners. The analytical techniques developed, and the resulting tools will support Forest Landscape Planning and successful implementation of the Great Bear Rainforest Land Use Order.

The Coastal Experimental Watersheds project, which continued through 2022–2023, has co-developed tools with Nanwakolas Council member Nations to support ongoing implementation of ecosystem-based management within the Great Bear Rainforest. Researchers designed a GIS-based tool to support selection of watersheds for the experiment and further evaluated these sites in the field in collaboration with Ha-ma-yas Stewardship and research staff at the Nanwakolas Council Society. Field experiments assessing watershed responses to management are being developed at first- and third-order watershed levels. New collaborative work was initiated this year with the Gitanyow First Nation on forest carbon modelling of partial cutting in their territory, with a goal of integrating research and Indigenous knowledge into land-use decision-making.

ECOSYSTEM HEALTH AND DISTURBANCE

Understanding the impact of human activities and natural disturbances on forest health

Ecosystem disturbance is being exacerbated by climate change. The Ecosystem Health and Disturbance Research Portfolio seeks to understand the impact of natural and anthropogenic disturbances, and to develop tools to mitigate these impacts. Land managers and resource specialists use the information and tools generated to better forecast forest pathogens and disturbance impacts. Research findings from this portfolio inform policy development, which results in improved, science-based ecosystem management. The following are highlights from the Ecosystem Health and Disturbance Research Portfolio in the 2022–2023 fiscal year.

Understanding Subalpine Fir Decline: Climate Change and the Western Balsam Bark Beetle

Subalpine fir is critical to the forest sector and ecological health in central and northern British Columbia, but mortality and stand decline are increasing throughout the province. A long-term study undertaken by program researchers confirmed that western balsam bark beetle is the major disturbance agent in subalpine forests, killing over two-thirds of subalpine fir in 11 one-hectare study plots. The beetles first kill the largest trees, while other mortality factors kill smaller trees. Rearing trials at various temperatures have shown that when climate parameters are suitable, the western balsam bark beetle may be able to switch from a two-year life cycle to a one-year life cycle. This, in part, may explain the rapidly expanding subalpine fir mortality in British Columbia's forests.

In 2022, over two million hectares in British Columbia were affected by the western balsam bark beetle (Figure 4), with almost 90% occurring within northern and coastal forests. Consequentially, program researchers are expanding a network of long-term research plots into northern and central British Columbia. In addition to studying the forest health implications of this bark beetle, researchers will also carry out climate, soil, and biogeoclimatic data assessments. This expanded plot network will provide crucial information on population dynamics of the western balsam bark beetle in increasingly stressed subalpine fir forests. The network will also help to identify potential differences between northern and southern ecosystems. This work will provide a more comprehensive understanding of the major mortality factors affecting subalpine fir throughout British Columbia and aid the development of new mitigation strategies to preserve an economically important species in British Columbia's forest industry.

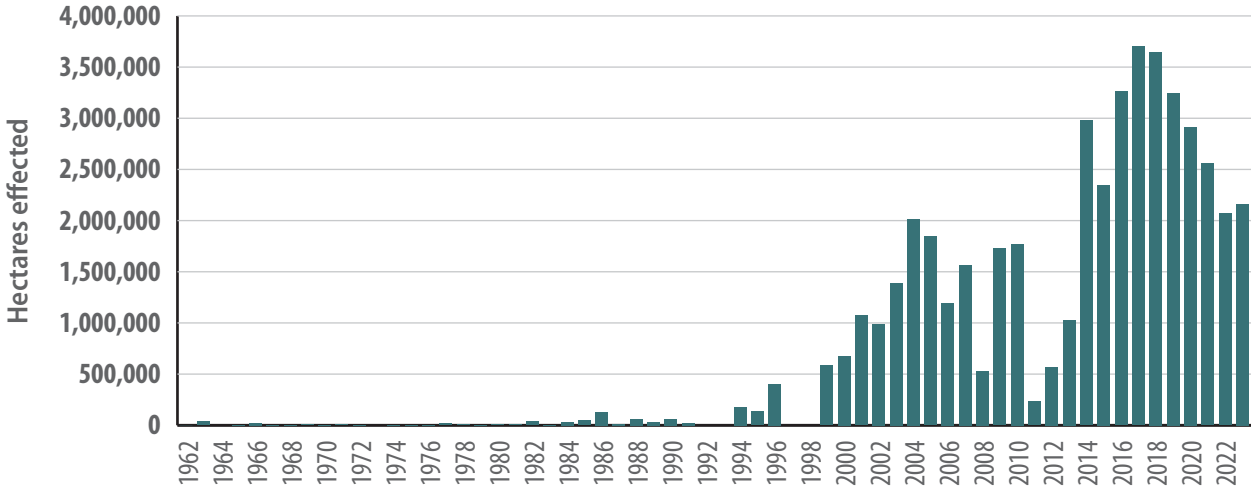


Figure 4. Hectares impacted by the western balsam bark beetle in British Columbia, 1962–2022.

Figure 5. High levels of balsam woolly adelgid trunk infestation.

Figure 6. Bud and branch node gouting on understory subalpine fir.

Establishment of Balsam Woolly Adelgid Impact Plot Assessment in Southeastern British Columbia

Introduced to North America from Europe in the early 1900s, balsam woolly adelgid is an aphid-like invasive pest that primarily kills subalpine fir. Currently, it is unknown what impact the potentially lethal sap-feeding insect has on British Columbia's interior subalpine fir ecosystems and how climate change may exacerbate associated risks from the pest. In 2022, researchers established three permanent sample impact plots in areas of known balsam woolly adelgid populations between Greenwood and Rossland (Jewel Lake, Phoenix Ski Hill, and Rossland). The objective of this long-term study is to establish a population baseline and then remeasure these plots over time.

The Jewel Lake site had the highest levels of trunk symptoms (Figure 5), with 30% of the trunk infested on 50% of the trees. At the Rossland site, high levels of subalpine fir mortality were observed. There were few stem infestations on overstory trees at any of the sites; however, the subalpine fir understory was greatly impacted, showing symptoms such as bud and branch node gouting (Figure 6).

Monitoring and Assessing Influence of Climate and Topography on Pine Rust Incidence

Over the past two decades, pine stem rusts have limited healthy forest regeneration and, in some areas, have impacted free-growing timelines. To understand the stem rust–lodgepole pine pathosystem (how host

lodgepole trees and parasites such as rusts interact) in northern British Columbia, researchers are conducting long-term monitoring of the incidence of Comandra blister rust, Stalactiform blister rust, and Western gall rust at a Comandra screening trial. In addition to the detailed rust assessments, this collaborative work uses weather station data, including temperature and relative humidity, to capture macroclimate and microclimate variables with a goal of monitoring the interactions between rusts and weather. This research is also helping to understand how climate change is impacting those interactions. Further study and forest health monitoring are underway to develop hazard mapping, impact modelling, and a loss mitigation strategy for pine rust.

Improving Post-Wildfire Hazard Predictions

British Columbia is experiencing increased wildfire activity with fires of larger magnitude and frequency, due in part to climate change. Climate change has also brought extreme weather events, which, coupled with wildfire-induced changes to soils and vegetation, have increased the occurrence of post-wildfire debris flows and floods. Field work, satellite imagery, and LiDAR (Light Detection and Ranging) data are being used to enhance our understanding of the conditions and precipitation thresholds for post-wildfire events.

Remote Sensing of Environmental Change

This project supports both research and operations with novel workflows that sift through vast satellite image archives. Ongoing projects include the detection of changes in natural and manmade water bodies in British Columbia, trend analysis of ecological and hydrological drought indicators, changes in the mountain cryosphere, and rapid detection of forest disturbance and recovery. This project has also hosted community learning and collaboration through a provincial community of practice and annual training events for practitioners and interested parties.

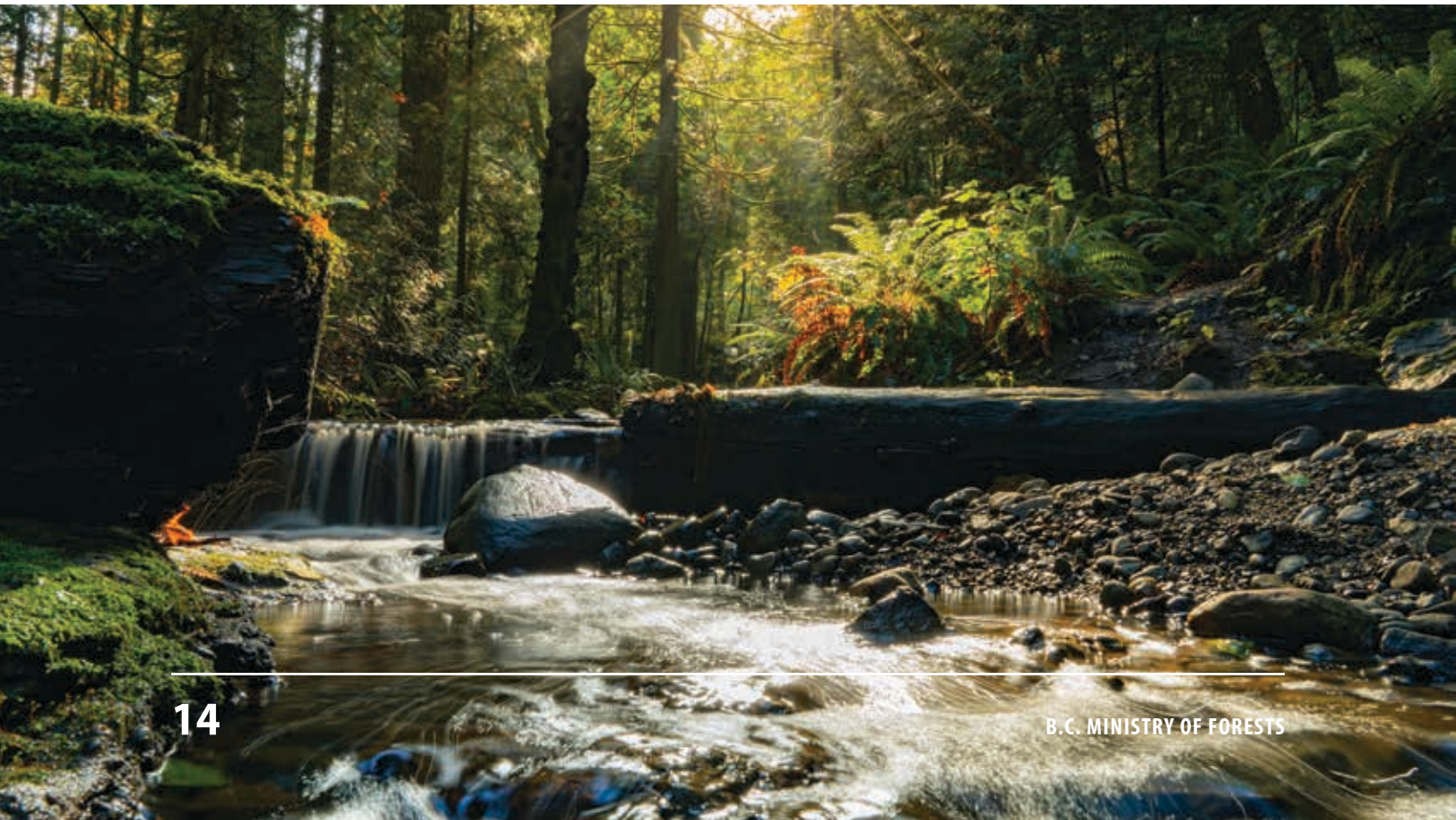
WATER

Understanding and protecting the watersheds, rivers, and streams in British Columbia

The Water Research Portfolio is furthering knowledge about water resources, including environmental flow needs and aquifer characterization, to support sustainable water allocations and public safety, which are being affected by climate stressors such as droughts and atmospheric rivers. This portfolio's projects help to address knowledge gaps through an increased scientific understanding of watersheds, surface water, groundwater, and geomorphic risks. Work also seeks to understand the effects of forest disturbance and regrowth on water quality and quantity and on public safety. The following are some highlights from the Water Research Portfolio in the 2022–2023 fiscal year.

Small Stream Riparian Management

Started in 2001, this project aims to assess how effective the Forest Practices Code/*Forest and Range Practices Act* has been in retaining trees in the riparian wetland areas around small and fishless streams, and whether enhanced tree retention occurred, per the legislation, on studied interior streams in British Columbia. The minimum retention levels stated in the *Forest and Range Practices Act* and Forest Practices Code do not yet meet the intended outcome of the legislation—to maintain stream function and biodiversity. This study demonstrated that the enhanced retention maintained 50–70% of pre-harvest shade, but air and stream temperatures increased more than 3°C on average and have taken more than 20 years to return to control conditions at some study sites. Recommendations from the project include increasing retention within the first 10 metres beside a stream to help ensure long-term supply of large trees for stream function, buffer temperature change, increase shade, maintain litterfall, and promote benthic invertebrate communities. Findings from this project have been used in Forest Stewardship and Forest Landscape Planning and in collaborative Indigenous agreements and shared through conferences, workshops, and articles.



Drought Stress: Stand-Level Drought Risk Assessment Tool

Initiated in 2015, the research that led to the development of the Forest Drought Risk Assessment Tool (ForDRAT) planned to integrate climate change into forest management, primarily timber supply analysis and harvesting/retention decisions. The ForDRAT tool has been developed and calibrated for Omineca, Kootenays, and Cariboo, and work is underway to make it provincially applicable. The tool projects tree mortality risk from future climate change–driven moisture stress. It is also used to inform silviculture practices to reduce the impacts of drought and has the potential to become part of a forest management policy that considers climate change. Recently, ForDRAT was used by Forest Analysis and Inventory Branch staff to assess the future risk of drought to timber supply in the Mackenzie Timber Supply Area, and it supported an assessment of the impacts of climate change for the recent annual allowable cut determination.

Innovations in Measuring Snow and Ice in Coastal British Columbia

Initiated in 2019, this project aims to improve snowpack estimation in coastal watersheds. This project uses LiDAR remote sensing technology combined with weather station data and field validation to quantify snow water volume across four watersheds: three on Vancouver Island and one in the lower mainland. Researchers are also applying a fully distributed hydrological model to produce maps of snow water equivalent between survey dates. Each watershed covers approximately 550 km^2, and one of the focal watersheds is the Russell Creek Experimental Watershed. Analysis from 15 LiDAR-based snow surveys conducted from 2020–2022 has shown that the majority of snow is stored between 1,000 and 1,600 metres elevation across all watersheds. Further, the timing of peak snow measurement was six weeks later in 2022 than previous years, with measured peaks within 5–10% of the years that data were collected. Information gathered by this research will inform policy and watershed management related to forestry, specifically hydrological recovery after forestry activities have ended.

Carnation Creek: Land and Resource Use to Support Healthy Aquatic Ecosystems

With an unprecedented 52 years of continuous watershed-scale multidisciplinary study, this long-term research installation is focussed on improving understanding of stream channels, including morphology, sediment supply (e.g., landslides), channel changing floods, and the long-term effects of forestry practices. This project is foundational for improving forest management practices and informing decisions that seek to maintain aquatic ecosystem health. The project has provided the scientific support applicable to the adjudication of Forest Stewardship Plans as well as best practices implemented on the ground, such as riparian management practices adjacent to small streams. The project also supports the provincial Watershed Security Strategy and wild salmon conservation priorities. Application of Carnation Creek's extension is coastwide across West Coast and South Coast Regions.

Prediction of Freshwater Spring Locations Using Random Forest Machine Learning

Freshwater springs hold high environmental, cultural, and economic significance, as well as hosting unique species and providing crucial microhabitats. However, their locations are influenced by various environmental and geological factors, making their prediction complex. Initiated in 2021, this project leverages random forest machine learning to predict the locations of freshwater springs, a significant step forward from traditional regression analysis methods. Applying the model to the Doig River area has showcased its versatility and transferability. Field validation of high-likelihood spring areas will help optimize the model and enable identification of areas for protection.

SPECIES AND HABITATS

Studying wildlife and their habitats for better management and conservation of biodiversity

The Species and Habitats Research Portfolio exists to investigate the protection, conservation, and management of species and habitats in British Columbia. Its research is focussed on the response of wildlife populations and their habitats to the cumulative effects of climate change and natural resource management. This strategic knowledge supports guidance and tools to inform immediate decision-making and the development of scientific understanding so that policies can respond to emerging pressures on fish and wildlife populations and their respective habitats. The following are some highlights from the Species and Habitats Research Portfolio in the 2022–2023 fiscal year.

Tracking Steelhead Movements and Mortality Locations

In British Columbia, many populations of steelhead are at extremely low abundance, particularly on Vancouver Island. To understand which factors are leading to their mortality, researchers used pop-up Argos satellite tags to track the movements, mortality locations, and mechanisms of steelhead kelts in the Northeast Pacific. Preliminary findings demonstrate long-range migration pathways of over 3,000 km (Figure 7); however, the majority of mortality events occurred within 100 km of release. These initial findings suggest that predation mechanisms were likely from marine mammals and active pelagic fishes.

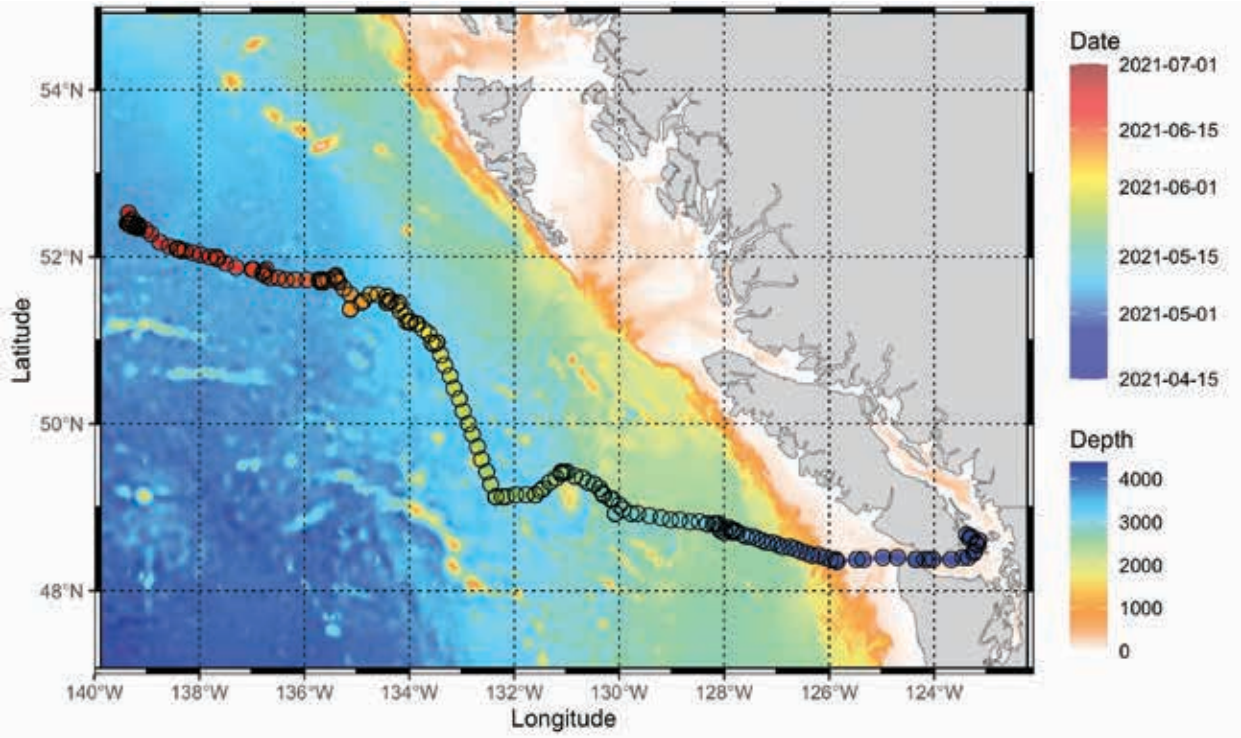


Figure 7. Estimated travel pathway of steelhead kelt captured and tagged in the Cowichan River (Vancouver Island) in 2021.

Endangered Northern Spotted Owl Habitats

Northern spotted owls are one of Canada's most endangered species of bird, and the species is at significant risk of extirpation (i.e., local extinction) from British Columbia. Recovery strategies for the endangered northern spotted owl in southwestern British Columbia include habitat management under the Spotted Owl Management Plan. Harvest with Retention and Habitat Enhancement Practices are general wildlife measures applied within designated Wildlife Habitat Areas. This research project focusses on designing a structured experimental framework with forest stand indicators to monitor, compare, and evaluate how forest stands harvested under general wildlife measures are developing into spotted owl habitat.

Identifying Western Screech-Owls' Vocal Signatures

Harvesting of mature, old-growth, and riparian forests used by the threatened coastal western screech-owl is of increasing public concern. Development of habitat management and monitoring strategies requires improved knowledge of home-range forest composition, areas, and spacing. Researchers have experimented with the use of autonomous recording units to determine if individual movement can be tracked and mapped by using recorded vocal detections on deployed grids of the units. This novel work is paired with a sound analysis recognizer software tool (under development) to support identification of individual screech-owl's vocal signatures from recordings for tracking and monitoring of their population.

Assessing the Vulnerability of Pacific Marten

Southwest coastal populations of Pacific marten are under threat from the cumulative effects of forest management, the spread of rural and urban development, increasing and intensifying coastal drought, and invasive species impacts such as disease. Working collaboratively with the trapping community, researchers used data collected from harvested carcasses to define the spatial extent and assess the potential vulnerability of coastal Pacific marten populations in British Columbia. Work continues to complete specimen, sample, and data collection and complete genetic and dietary isotope analyses.

Climate Change and Grizzly Bear Population Trends

Grizzly bear populations are limited by mortality, but the extent to which food quality and quantity influence their abundance within forest ecosystems is not clear. This research is designed to understand what foods limit bear abundance and how temporal variation in food abundance affects population trends. A better understanding of food limitation will allow managers to propose effective silvicultural or habitat enhancement treatments, predict the effects of annual weather on bear numbers, and consider the influence of climate change on grizzly bear populations.

Kokanee Salmon and Groundwater Upwelling

In collaboration with the University of British Columbia Okanagan and Friends of Kootenay Lake Stewardship Society, groundwater flow patterns are being assessed in shoreline spawning habitat for a population of kokanee salmon in Kootenay Lake. This population spawns in areas of upwelling groundwater, and over-winter reservoir drawdown for hydropower production leads to stranding of some fry and their gravel nests, or "redds" above the water line. This project investigates changes in groundwater upwelling rates over the egg development period at different water depths to assess the efficacy of enhancing spawning gravels lower in the water column to avoid loss of water where female salmon have laid eggs in the riverbed.

Mule Deer Survival, Mortality, and Migration

Mule deer are a primary source of food security for interior Indigenous Peoples and the most important game animal in British Columbia in terms of licence sales and expenditures. Researchers are studying mule deer survival, mortality, and migration in southern British Columbia through the use of GPS collars on 19 fawns and 40 adults in five areas. Extensive research was also initiated in this part of the province to examine mule deer responses to wildfire and habitat changes.

Impact of Wildfires, Mountain Pine Beetles, and Salvage Logging on Moose

During this reporting period, researchers have been assessing whether landscape changes from the mountain pine beetle outbreak and associated salvage logging are related to moose population declines. Results are generally inconsistent with this landscape-change hypothesis, which assumes that cow survival is the primary driver of population change.

In addition, increasing severity, frequency, and size of wildfires in British Columbia's Central Interior should result in a pulse in moose forage in the coming years. Researchers aim to quantify moose forage sites at the fire scale to determine where and how reforestation activities can minimize negative effects on moose forage and maximize the potential of post-wildfire landscapes to contribute to moose habitat enhancement.

TIMBER SUPPLY

Understanding the impact of climate change on timber supply

The Timber Research Portfolio supports the establishment and stewardship of forests and the maintenance of timber supply. It develops and improves existing resource models to better estimate timber supply and range productivity, and it supports integrated decision-making in the face of a changing climate characterized by more frequent and severe disturbances, as well as competing demands for other values. This research portfolio helps sustain vibrant and diverse forests and a timber supply that supports communities. The following are some highlights from the Timber Research Portfolio in the 2022–2023 fiscal year.

Assessment of a Mixed Western Redcedar/Red Alder Plantation in Southwestern British Columbia

In a 20-year replacement series trial containing mixed and pure stands of western redcedar and red alder, researchers are investigating site-level functional relationships between cedar and alder, and the importance of species mixture composition and density, spatial patterns, and temporal dynamics. In cedar plantations, growth may be enhanced by planting a 1:1 mixture of cedar and alder, due to the beneficial effects of alder on soil fertility. At the stand level, cedar volumes have increased three- to four-fold since year 13, while alder stand volume increases have been low to moderate (1.5- to 2.0-fold). Future investigations will be needed to substantiate these trends and the repercussions on cedar productivity. However, these observations indicate that cedar in combination with alder may further benefit productivity as stands continue to develop with the support of enhanced soil fertility associated with the alder component.

Low-Severity Wildfire Prevents Catastrophic Effects on Fungal Communities and Soil Carbon Stability in a Fire-Affected Douglas-Fir Ecosystem

The frequency, size, and severity of wildfires are increasing globally and in British Columbia. These shifting fire regimes have significant consequences for forest carbon budgets. Most carbon in temperate forests is stored below ground, but how this carbon pool responds to a range of fire severities remains a key research gap. Understanding this process is critical for developing post-fire carbon management strategies. Soil carbon and fungal communities in stands affected by moderate- and low-severity wildfires are largely resilient, yet high fire severity is associated with declines of 48% in below-ground carbon stocks, primarily due to combustion of the forest floor but also due to losses in the top 5 cm of mineral soil. Ectomycorrhizal fungi (associated with tree roots), which acquire nutrients and water for trees, are highly sensitive to wildfire, but effects are most acute in the moderate- and high-severity treatments. Fungal communities affected by high-severity wildfire are dominated by pathogenic fungi, as well as stress-tolerant species. Regenerating seedlings in stands affected by high-severity wildfire will be exposed to carbon-limited soils with high pathogenic activity. The effects of these environments on regenerating seedlings are not yet clear, but the situation represents a clear risk and a source of future forest health problems for stands severely impacted by wildfire. Furthermore, this project provides much-needed estimates of fire effects on total ecosystem carbon stocks; these estimates are widely used in government forest carbon modelling.

Post-Fire Regeneration Experiment—Gustafson Installation

The 2017 wildfires devastated large areas of the Interior Douglas-fir biogeoclimatic zone, particularly in the Cariboo Region, and post-fire management and silviculture practices that expedite post-fire Douglas-fir regeneration in drier ecosystems are urgently needed. Four silvicultural treatments (i.e., no-harvest underplant, salvage logging without site prep, salvage logging with site prep, salvage logging with high retention of coarse woody debris) were selected to evaluate regeneration success of planted Douglas-fir in the dry,

cool Interior Douglas-fir subzone of the Cariboo Forest Region. Conventional clearcut treatment resulted in a similar magnitude of seedling mortality compared to the salvage logging with mechanical site preparation treatment. Underplanted seedlings with high coarse woody debris retention were buffered from the extreme heatwave effects and showed decreased seedling mortality during the 2021 heat dome event. Salvage logging, coupled with mechanical site preparation, intensified these effects due to the amplified thermal exposure on the mineral soil. Further work will help to determine which of the four silvicultural treatments promotes seedling survival and establishment on severely burned, frost-prone, and drought sites in the Interior Douglas-fir biogeoclimatic zone.

Developing Climate-Sensitive Tree and Stand Simulator (TASS) Models Using Transfer Functions

Climate change adaptation policies governing timber supply analyses and silviculture practices will require the adjustment of managed stand yield predictions for a likely range of climate scenarios. These scenarios can be evaluated through simulations using TASS models. Researchers developed climate-sensitive height and mortality functions for lodgepole pine to address this need at the stand and landscape levels in British Columbia. Rates of survival under climate change will vary according to the climate of the seed source. Areas where the contemporary climate is cold and dry will likely experience improved survival in the short term. However, longer term, a decrease in overall survival for lodgepole pine is expected in British Columbia, given predicted warming trends. The study demonstrates application of the survival transfer function to predictions of stand-level stem counts and the combined transfer function of site height for stand-level volume for lodgepole pine stands.

BIO-ECONOMY

Supporting the development of British Columbia's innovative green economy

The Bio-Economy Research Portfolio aims to enhance knowledge of alternative forest resources and products and to support climate change mitigation, with research on carbon, fibre, and market analysis. It supports the government and industry with operational, technical, and resource management science and information to reduce investment uncertainty associated with new revenue streams. The following are some highlights from the Bio-Economy Research Portfolio in the 2022–2023 fiscal year.

Verifying the Relationship Between Soil Carbon and Manganese Content

Innovative carbon storage solutions are needed to mitigate wide-ranging effects of climate change on ecosystems within the forest biome and economies reliant on them. Recent Ministry-led research in coastal British Columbia found that manganese (Mn) fertilization holds some promise as a soil amendment that promotes biologically mediated soil carbon storage in forest ecosystems.[1]

Pilot funding from the Bio-Economy portfolio continues to be used to locate additional sites in British Columbia that can verify the relationship between soil carbon and Mn content. Additionally, funds will be used to develop molecular tools that can rapidly detect the activities in soils of manganese peroxidase, a key enzyme responsible for the decomposition of complex organic matter. Ultimately, the goal is that this research will lead to the development of a Mn fertilization or manipulation program that can increase carbon sequestration in forest soils and mitigate the effects of climate change.

Empirically Testing Wood Product Substitution Assumptions

Forest carbon policy depends on analysis of different climate change mitigation strategies. This analysis often depends on the assumption that 100% of harvest reductions will be replaced or substituted with concrete, steel, or other products with greater carbon footprints. Testing this assumption to ensure sound policy and decision-making is the basis of this project.

From 1988 to 1998, timber harvest levels dropped steeply on public lands throughout the United States, providing an opportunity to empirically evaluate product substitution in response. Researchers conducted a market-share analysis for 1988 and 1998 of all softwood lumber products and their alternatives, such as wood, aluminum, vinyl sidings, stucco, and brick siding. They then analyzed how the market shares changed and how harvest, imports, exports, and other elements of softwood lumber supply changed. Overall, between 8 and 14% of the harvest reduction resulted in higher emissions products being utilized, rather than the 100% previously assumed (Figure 8). These results demonstrate that assuming alternatives will replace wood products following conservation through reduced harvest will not necessarily put us on the best path towards reducing emissions. Instead, we should consider conservation in a portfolio of carbon management options and maintain or enhance policies to increase the likelihood that wood products will be used.

[1] Kranabetter, J.M., T.J. Philpott, and D.E. Dunn. 2021. Manganese limitations and the enhanced soil carbon sequestration of temperate rainforests. Biogeochemistry 156:195–209. DOI:10.1007/s10533-021-00840-5.

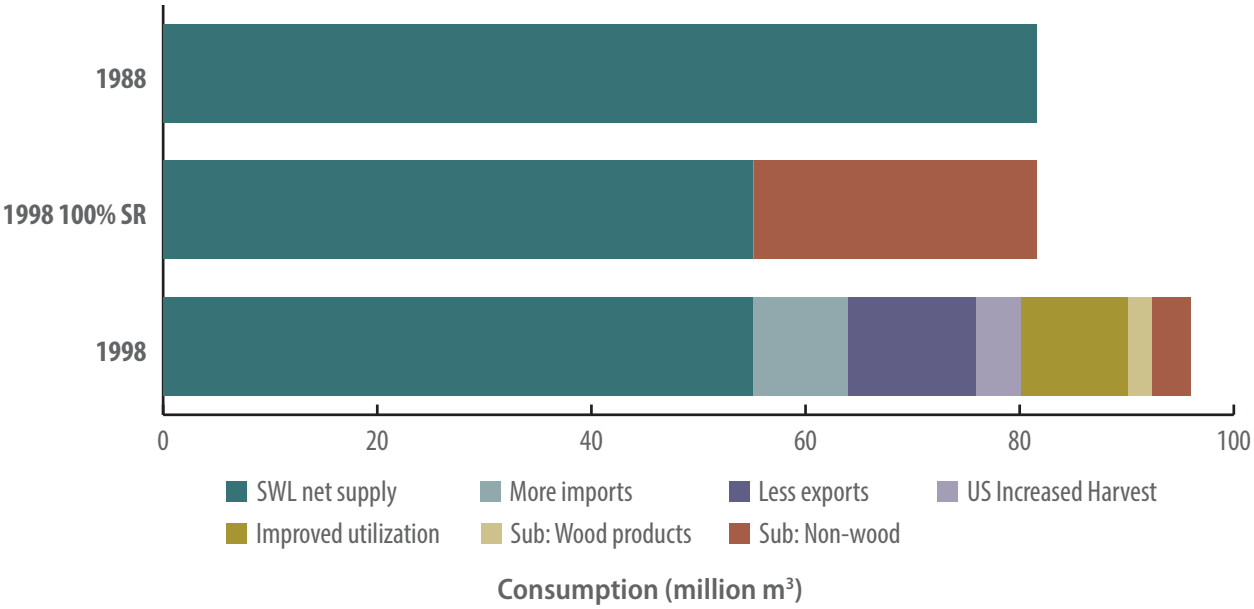


Figure 8. Consumption of softwood lumber and alternative products in the United States in 1988 and 1998. The dark green bars show the harvest in 1988 and the change in harvest due to reductions on public land in 1998. The middle bar shows the current assumption in typical climate change mitigation studies, with no change in total consumption and 100% of the reduction in harvest being replaced by non-wood products (Sub: non-wood). The lower 1998 bar shows the result of this case study with increased total consumption and an array of adaptations by the wood products market with a much smaller amount of substitution by non-wood products (8-14%). SWL = softwood lumber, SR = substitution ratio

Forest Genetics Group

Given the specialized nature of its work, the forest genetics group operates adjacent to the six research portfolios. It is focussed on improving the value, resilience, and conservation of British Columbia's forest genetic resources to maintain healthy, productive forests and help mitigate the impacts of climate change. The group's research focusses on six areas: adaptive physiology in tree breeding, cone and seed pests, genetic worth for timber supply, deployment issues and genetic diversity in tree breeding, breeding values of tree seed, and realized genetic gain trials.

Forest health continues to be an important component for genetics programs. In the 2022–2023 fiscal year, the group continued screening for Swiss needle cast in the coastal Douglas-fir program, and established a pipeline for large-scale screening for cedar leaf blight in the coastal western redcedar program. Realized gain trials were also established across British Columbia for the Sitka spruce program. The group re-initiated nursery trial screening of the operational yellow cypress hedges at Cowichan Lake Research Station and Saanich Seed Orchard to ensure quality stecklings are available to industry. As part of gene conservation, seeds of Garry oak from various locations were successfully grown at Cowichan Lake Research Station for gene archiving in the upcoming fiscal year.

The forest genetics group is establishing breeding arboreta for ponderosa pine and western red cedar in the Interior and sowed the first series of ponderosa progeny trials. The group expanded disease collections and is developing or refining experimental methodology to screen for genetic resistance to white pine blister rust in whitebark pine, armillaria root rot in Douglas-fir, and red-band needle blight in lodgepole pine. Second-cycle progeny trials have been established and are being evaluated for all interior Douglas-fir, western larch, and Southern Interior spruce populations, from which selections will be made to establish new seed orchards. The lodgepole pine program has focussed on establishing field trials to widen the screening for resistance to Comandra blister rust and ultimately provide selections for new disease-resistant orchards. New interior white pine progeny trials are being established to evaluate superior parents for growth and white pine blister rust resistance. Finally, the group used drones to characterize individual trees in field trials and used provenance trials to create a climate-sensitive growth and yield model.

For more information about the work of the forest genetics group, visit Forest Genetics.

First Nations Collaborations

During the 2022–2023 fiscal year, the Research Program continued building research collaborations with First Nations and finding opportunities for engagement activities. Projects and collaborations that were underway in 2022–2023 included the following.

Upper Peace River Stream Temperature Modelling Project

The study is an example of external collaboration supported by Research Program scientists investigating the eco-hydrological dynamics of the Upper Peace River Basin. Researchers installed ten hydrometric stations and over 80 stream temperature sensors; they compiled remote sensing data sets of land surface temperature and forest disturbance and have conducted watershed disturbance modelling. Combined, these data sets are being used to model stream temperatures spatially and temporally to better understand the thermal dynamics of the region and improve our understanding of how cold water–adapted fish species are likely to be impacted by climate change and land use.

This research has the potential to guide conservation efforts and contribute to sustainable management of the river's resources and biodiversity, benefiting both the Tsay Keh Dene First Nation and the broader ecosystem. This project addresses Objective 3.3 (Identify Climate Change Risk to Watersheds) of the Tsay Keh Dene–B.C. Government Environmental Stewardship Initiative. The work also allows the Ministry of Forests, Tsay Keh Dene, and other First Nations to identify areas of cold-water refugia for priority species (Bull Trout and Arctic Grayling) where conservation or restoration actions will be beneficial in the long term.

Developing Biogeoclimatic Ecosystem Classifications with Tāłtān and Taku River Tlingit First Nations

British Columbia's framework for ecosystem management, the Biogeoclimatic Ecosystem Classifications (BEC) system, has not yet been completed across the province. The most northwest corner of British Columbia is one of the last areas remaining without a field guide for ecosystem identification. The Research Program developed relationships with the Tāłtān (Tahltan) and Taku River Tlingit First Nations to collect data for ecosystem classification in their territories. Together with Land Guardians from both nations, researchers completed two weeks of remote field work in both 2021 and 2022.

Technical staff from all three governments are building shared concepts of typical plant communities and their associated soils, forest productivity, and wildlife. Spending time together on the land is also building shared understanding across cultures and shared experiences. The project was based out of Dease Lake in 2021, and staff mainly sampled undifferentiated sub-boreal spruce ecosystems in Tāłtān territory. In 2022, field teams worked out of a mining camp in the Taku River drainage, a fish camp on Tahltan Lake, Atlin, B.C. The teams covered both Tāłtān and Tlingit territory and expanded sampling to lower and higher elevation ecosystems. The field guide resulting from this project will also reflect the knowledge and input of the people indigenous to these ecosystems.

First Nations Forestry Council Student Scholarship

In August 2022, Chandell Dillman, a First Nations ecological restoration student placed with BC Timber Sales as a resource assistant in the Cariboo-Chilcotin business area, joined Cariboo Region researchers for a two-week work placement. Chandell was mentored by Cheryl Williston, team lead of planning, assessment, and research for the Cariboo Region, and conducted research at both Meldrum Creek and Mount Tom research installations. She assisted in the assessment of aspen-pine competition in young stands and investigated viable silvicultural management systems while maintaining mountain caribou habitat.

"Chandell was eager to learn, and great to have out in the field with us. Her passion for learning and getting into the resource management field is very evident." – Cheryl Williston

About the Indigenous Forestry Scholarship Program

This program has been developed by the B.C. First Nations Forestry Council in partnership with the Ministry of Forests, and is delivered in partnership with BC Timber Sales, BC Wildfire Service, Mosaic Forest Management, Tolko Industries Ltd., Western Forest Products Inc., and the Indigenous Skills and Employment Training Program. It is a work and study mentorship program designed to grow Indigenous talent and connect Indigenous people with workforce opportunities in the B.C. forest sector.

Old Growth Forests

Old growth forests provide multiple ecological values, including species habitat, carbon sequestration and storage, and stabilization of riparian areas, among others ecosystem benefits. During the 2022–2023 fiscal year, Research Program scientists played a key role as subject matter experts in supporting the Ministry's implementation of the Old Growth Strategic Review. Research is also being undertaken on the dynamics of old growth forests, how they recover from disturbance, their carbon dynamics, and the associated implications for climate change mitigation. The following are some examples.

Old Growth Forests in the Interior Rainforest

British Columbia's interior mountains are also home to interior rainforest ecosystems. Research Program researchers are working with the University of British Columbia to quantify carbon storage and stand structural attributes in the wettest subzones of the Interior Cedar Hemlock zone in the Southern Interior. The project randomly sampled old forests, mapped as > 250 years old in the provincial Vegetation Resource Inventory, and ancient forests, known to be > 400 years old as identified from existing field observations. Carbon stocks are being calculated for various carbon pools: live and dead trees (standing and fallen), understory vegetation, forest floor, and soils. Future research will quantify the net carbon implications of different management strategies in interior rainforests, building on work being done in coastal forests.

Structural Attributes of Old Forests in British Columbia's Diverse Ecosystems

The characteristics of old forests vary widely across British Columbia, from coastal and interior rainforests to dry, open ponderosa pine forests in the Southern Interior, boreal forests in the north, and high-elevation mountain forests. Building from the biogeoclimatic ecosystem classification (BEC) system, researchers are using existing data sets from forest inventory and research projects to develop baseline information on old growth characteristics such as density and size of large trees, snags, and logs. Pilot studies are underway in the dry subzones of the Coastal Western Hemlock zone and in the wet and very wet subzones of the Interior Cedar Hemlock zone. Additional work is planned for ecosystems in the central plateau portion of the province. This information can help to inform management decisions, including conservation, recruitment of future old forest stands, and restoration activities.

Carbon Dynamics of Coastal Old Growth

Forests are considered sinks when they absorb more carbon dioxide out of the atmosphere than they respire, and sources when they emit more than they store (e.g., through fire and decomposition to the atmosphere). Quantifying the net carbon implications of different forest management strategies is therefore critical to making informed decisions to promote forest maintenance as a carbon sink rather than a source. In this project, researchers created three hypothetical landscapes of different productivity levels using field data from more than 2,000 Coastal Western Hemlock research sites. These landscapes provide a general picture of wet forests in coastal British Columbia. A forest landscape model simulated carbon dynamics in the forests including three management regimes and windthrow disturbances. The hypothetical landscapes were all 250 years old at the beginning of the simulations. This study is now developing systematic approaches to integrating all carbon sinks and sources to quantify the climate mitigation potential of forest management strategies and provide decision support to forest management and policy-making.

Results analysis showed that in conservation scenarios, the Coastal Western Hemlock forests are a small carbon sink at the start of simulations and switch to being a small source after about 150 years. Inducing clearcut with 70- or 125-year rotation periods shifts the 10,000-ha landscape into a large carbon source in the decades when it is being converted to a managed landscape, and into a smaller source in the long term. (These results include product substitution benefits.) Even though forest regrowth increased carbon sequestration in the ecosystem, that positive did not balance the large emissions from decaying soil and deadwood, and cradle-to-grave carbon emissions from harvested wood products. A sensitivity analysis of climate change impacts on growth rates found only a small influence, much less than the impact of management. Next year, fiscal 2023–2024, will see cost-benefit analysis, optimization studies, and similar projects being developed in the Interior Cedar Hemlock zone.

For more information on how researchers are studying the characteristics of old-growth forest ecosystems of coastal British Columbia across space and time, visit the Coastal Old Growth Dynamics Project.

Together for Wildlife

Together for Wildlife (T4W) is the provincial strategy to improve wildlife and habitat stewardship across British Columbia. It includes contributing funding, proactive objectives, and improved data and knowledge—all supported by new policies, strong partnerships, and dedicated resources. The strategy consists of five goals and 24 actions. Goal 2, Action 5, focusses on the need to support priority research for wildlife stewardship through contributions to post-secondary institutions and to ensure that results of this research are shared broadly with British Columbians.

In spring 2022, T4W partnered with the Interior University Research Coalition to issue a call for proposals for student research grants. Six projects spanning four geographic areas of the province and a range of priority research areas were awarded grants. Below are two highlights.

Jeff Nishima-Miller (UBC Okanagan) is leading a project in collaboration with the Xeni Gwet'in community on Indigenous-led wildlife management, with the purpose of advancing the design and implementation of its wildlife management strategy. An advisory team has defined the vision, goals, and priorities for wildlife management within the Xeni Gwet'in Caretaker Area. One success of this research has been aligning the vision, goals, priorities, and actions for wildlife management with other active community plans including the Xeni Gwet'in forest management strategy, comprehensive community plan, sustainable agriculture strategy, climate change adaptation plan, Nen (land and water) planning activities, vision for sustainable development, and Tsilhqot'in impact assessment framework.

Spencer Greening (Simon Fraser University) is undertaking interdisciplinary research that explores Indigenous resource and wildlife management by narrating the Gitga'at First Nation's historical relationship with the Laxgalts'ap watershed. Through field work and personal interviews, Spencer has been able to blend Gitga'at ecological teachings and archaeological evidence of harvest with evidence of thousands of years of occupation within this watershed to help inform stewardship of mountain goats and salmon. This project has opened doors to pursue further cultural initiatives with the Gitga'at Health Department, where he can continue to blend harvesting and research while teaching youth about cultural conservation practices surrounding those species.

In February 2023, T4W announced its second call for student research proposals in partnership with the First Nations–B.C. Wildlife and Habitat Conservation Forum and Habitat Conservation Trust Foundation. Fifty-three applications were received from seven academic institutions. Review and awards are underway.

For more information on the Together for Wildlife recipients and work related to research, visit Together for Wildlife.

Forest Bioproduct Research and Development

The concept of the forest bio-economy is to use forest biomass known as wood fibre to create bioproducts, such as consumer goods and industrial products, that can replace petrochemical-based products. The goal of developing British Columbia's forest bio-economy is to maximize the socio-economic and environmental potential of the province's harvested biomass while increasing the value of our forest fibre.

The Ministry contributes over $2 million annually to champion innovative bioproduct research and Indigenous bio-economy endeavours. The Innovation, Bioeconomy and Indigenous Opportunities (IBIO) Branch, as the provincial leader in forest bio-economy, manages this funding to propel British Columbia's forest economy forward through research and innovation programs and initiatives. Collaborating closely with research institutions, industry partners, First Nations, and the federal government, IBIO strives to advance and commercialize high-value innovative bioproducts.

IBIO supports a variety of organizations to deliver bio-economy-related research including the programs for bioproduct development, biomass availability information, and Indigenous bio-economy development. These organizations include FPInnovations, the University of British Columbia, the University of Victoria, Kwantlen Polytechnic University, and others. Projects focus on the development of innovative bioproducts, notably in six strategic focus areas including lignin, biocomposites, textiles, biochemicals and biomedical materials, and packaging.

Recognizing the vital role of Indigenous communities, IBIO's Indigenous bio-economy development programs focus on Indigenous community-driven initiatives and collaborations in the bio-economy sector. IBIO supports various programs and research projects aimed at fostering economic growth, preserving cultural heritage, and championing sustainable practices within Indigenous communities.

IBIO's commitment extends to continued collaboration with research organizations, industry stakeholders, and First Nations, with the shared goals of developing and manufacturing high-value bioproducts in British Columbia for global markets and empowering Indigenous bio-economy programs to enhance the involvement and benefits for Indigenous communities.

Wildfire Research

BC Wildfire Service (BCWS) and the Research Program maintain ongoing, active communication to best leverage resources and support research efforts. In 2022–2023, BCWS collaborated with Research Program scientists on projects that included studying tree recruitment after fire, protecting drinking water, and assessing wildfire risk in different forest management stand types.

Research and Innovation—BC Wildfire Service

The BCWS Research and Innovation business area focusses on research that generates knowledge and actionable insights alongside iterative and agile innovation trials, with a view to strengthening and modernizing delivery of the BCWS mandate of wildfire management and natural hazard emergency preparedness and response for British Columbia. All projects are aligned within four themes, though some are multidisciplinary. The themes are health, wellness, and safety of wildland fire personnel; social science; wildland fire science; and equipment and technology innovation.

The Research and Innovation team also focusses on building partnerships, such as with the Office of the Chief Forester's Research Program, and works with universities, third-party research organizations, and other groups to address priority research questions. It relies on its partners' diverse expertise and research fulfillment capacity. Some of the team's partners include Canada Wildfire; FPInnovations; Canadian Interagency Forest Fire Centre, Fire Science Committee; and academic institutions including but not limited to the University of British Columbia, Thompson Rivers University, the University of Victoria, and the University of Alberta.

Examples of projects that have progressed or been completed in the last year include research into wildland fuels, fuel treatments, and fire regimes. Examples of ongoing projects include research on cultural and prescribed fire, mitigation options for smoke and particulate exposure, and wildfire preparedness.

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