Effects of 2023 Wildfires in Alberta

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Report summary

The Alberta fires of 2023 were remarkable, at least in recent history.

- With 6.6% of the forested area of the province burned, the 2023 fires disturbed as much forest in Alberta as 11 previous fire years combined.
- All forest types and ages were affected, with the greatest area burned in the northern and west-central parts of the province.
- Average forest age declined across the province and dropped substantially in the most affected regions.
- Many older-forest species lost moderate amounts of habitat in localized areas, while a few fire-specialists will thrive in the newly burned areas.

Introduction

Fires are a natural occurrence in Alberta's forests. In boreal and montane forests, fires—along with other natural disturbances such as insect outbreaks and disease—create a mosaic of stands of different ages. This diversity in forests supports wildlife and plants that have adapted over thousands of years to these frequent disturbances.

However, 2023 was an exceptional year for wildfires in Alberta, with over 1,000 fires burning nearly 3.3 million hectares of forest across the province, including Wood Buffalo National Park where nearly 750,000 ha burned. Widespread fires forced people from their homes, destroyed property, and created smoky conditions and poor air quality across North America. Many of these fires continue to burn, even through the subsequent winter[1].

Extreme fire years have the capacity to dramatically affect forest biodiversity and have become more common in recent decades[2]. While fires are a natural process, and burned forests will regenerate over time, it is also important to consider the impact of fires alongside human activities such as forestry and energy development. Fire, forest harvesting, and other natural and human disturbances all change the ecological character of our landscapes in different ways.

This report looks at the ecological changes caused by wildfires in 2023 – how they affect forests in Alberta and the habitats of species that live there.

Methods

We used preliminary maps of 2023 forest fire areas as of Oct. 18, 2023, provided by the Government of Alberta[3]. Most fires in the province were extinguished or contained by that date. We summarized how much area burned in different regions of the province, including natural regions and subregions, caribou ranges, and Forest Management Agreement areas. We used province-wide vegetation maps created as part of our ongoing monitoring work to report the types and ages of forest burned, and how the average age of forest stands changed due to the 2023 fires. Results focused on the forested portion of the province, including the Boreal, Foothills, and Canadian Shield regions. Fire data was not available for the mountain national parks at the time of writing, but we do include fires within Wood Buffalo National Park in our summaries. Habitat models for many species allowed us to calculate how the changes in forest types and ages might affect species; we present highlights from these results.

Previous work by the Alberta Biodiversity Monitoring Institute summarized how much area burned in different regions and forest types between 2010 and 2021, and the extent of industrial activities such as forestry and energy development[4]. This reference period was chosen not because it necessarily represents a historically "normal" fire regime—in fact, fire activity in this decade is already above longer historic normals[5]—but because it is the period for which we have reliable and consistent fire and human footprint data. This work is intended to put the fires of 2023 into a "living memory" context.

For a detailed description of methods, see ABMI 2023[4].

[1] https://www.arcgis.com/apps/dashboards/3ffcc2d0ef3e4e0999b0cf8b636defa3

[2] Whitman, E., S.A. Parks, L.M. Holsinger, & M.-A Parisien. 2022. Climate-induced fire regime amplification in Alberta, Canada. Environmental Research Letters, 17(5), 055003. https://doi.org/10.1088/1748-9326/ac60d6

[3] The fire maps are preliminary with approximate boundaries; detailed mapping of fire perimeters and fire skips was not yet complete when the data was accessed. These preliminary maps likely overestimate the total area burned. However, the maps do capture the location and size of all notable fires within the province, including Wood Buffalo National Park. The maps do not include the mountain parks (Banff, Jasper, and Waterton National Parks) nor most of the non-forested prairies, grasslands, or parklands, but there were only a few hectares burned in these areas in 2023.

[4] ABMI. 2023. Summaries of the Effects of 2023 Fires in Alberta: Supplementary Report. Available at: https://abmi.ca/home/publications/601-650/642.

[5] Tymstra, C., D. Wang, & M.-P. Rogeau. 2005. Alberta wildfire regime analysis. Alberta Sustainable Resource Development, Forest Protection Division, Wildfire Policy and Business Planning Branch. https://doi.org/10.5962/bhl.title.113828

Results

How much area burned?

- Overall, 32,769 km^2 had burned by mid-October 2023, an area roughly the size of Vancouver Island, or 5.0% of Alberta (Figure 1).
- 7,468 km^2 or 20.6% of Wood Buffalo National Park burned, an area larger than Banff National Park.
- That means that roughly 6.6% or one-fifteenth of Alberta's forested area burned in the summer of 2023. If that happened every year, any place in Alberta's forest would burn on average once every 15 years i.e. a 15-year "fire return interval".
- In comparison, roughly 0.6% of the forested area burned per year on average from 2010 to 2021, for a return interval of approximately 165 years. The year 2023 was equivalent to 11 recent years of fires in the forested regions of the province.
- 24,230 km^2 or 6.9% of the forested Green Area of Alberta burned (i.e., does not include grasslands and parklands, most settled lands, and Wood Buffalo National Park).
- Human development impacted 0.34% of the Green Area on average each year from 2010 to 2021. When fire and human activities are combined, an average of 0.95% of the Green Area was disturbed each year from 2010 to 2021.
- These numbers represent coarse-scale averages. Historical fire return intervals are variable across different parts of the Boreal, and our understanding of older fire patterns (i.e., pre-1980s) is limited and not incorporated into this assessment.

Areas burned in 2023

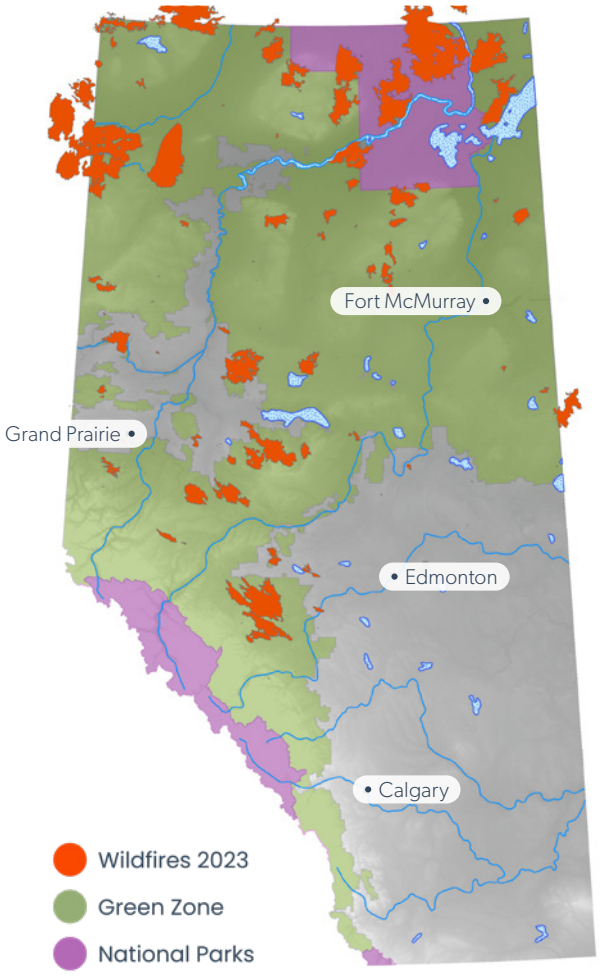

Figure 1

Percent burned by habitat type

- Fires burned from 5.5% to 8.6% of broad habitat types (e.g., deciduous forest, mixedwood forest, etc.) province-wide in 2023, equal to return intervals of 18 to 12 years; only open dry areas, found mostly in the prairies, had low rates (Figure 2).
- In comparison, from 2010 to 2021, fires burned from 0.37% (deciduous) to 1.20% (pine) per year. Human footprint added an additional 0.07% to 0.80% to that annual disturbance rate, for a total of 0.85 to 1.84% disturbed per year.
- Fires in 2023 burned 4.3 (mixedwood) to 9.4 (treed lowland) times as much forest as was disturbed by fires and human activities combined in recent years.
- Forests of all ages burned in 2023, though a slightly higher proportion of younger stands (10–60 years) burned than older stands (Figure 3).

Percentage burned by year

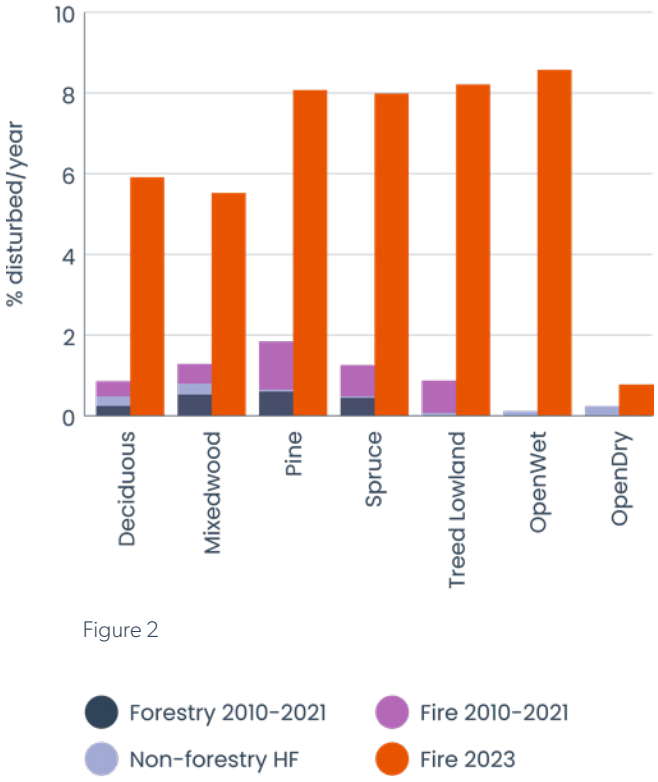

Figure 2

Percentage burned by age

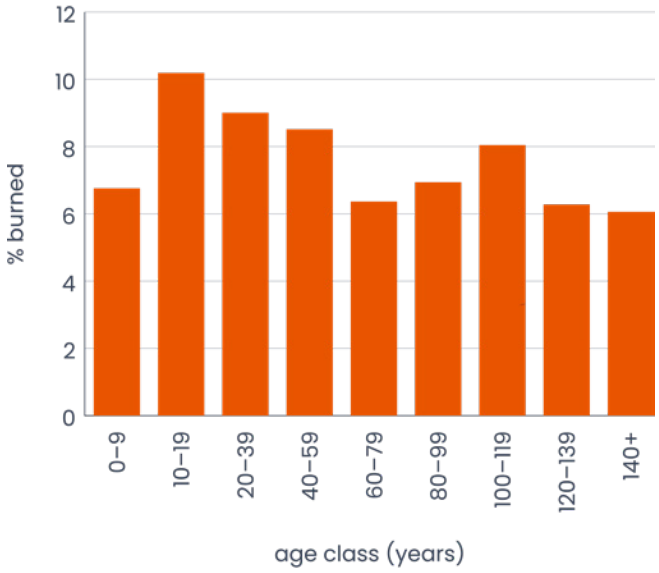

Figure 3

Differences among areas

The extent of what is burned and where is a combination of fire dynamics (i.e., where ignitions occur, how much fuel is locally available, etc.) and the firefighting response. As a result, some areas of the province were more heavily impacted by fires than others (Figure 4).

Ecosystems

Most of the big fires in 2023 were in the north and west-central parts of Alberta. Some ecosystems had a much higher percentage burned than the province overall. The remote Canadian Shield in the northeast corner of the province was 28.3% burned. The populated Lower Foothills subregion, used extensively by industry, had 10.4% of its area burned.

Parks

11.8% of the area in parks across Alberta was burned, dominated by >20% burned in each of three of the largest parks: Wood Buffalo National Park (20.6%), Kazan Wildland Provincial Park (27.4%), and Caribou Mountains Wildland Provincial Park (26.8%). Parks provide space for ecologically valuable unsalvaged fires, which have become rarer in recent decades. However, excessively high fire rates, if they are repeated in future years, could impact the ability of affected parks to maintain other ecosystem values.

Forestry operating areas

Current sustainable forestry is an ecosystem-based management approach in which forest harvesting is intended to resemble the landscape patterns and vegetation structure which result from wildfires in Alberta. Some forestry companies had no fires on their operating areas in 2023, but several had from 10% up to 33% of harvestable-age forest burn. This represents the equivalent of more than a decade of forest harvest, impacting assessments of harvest sustainability in the future.

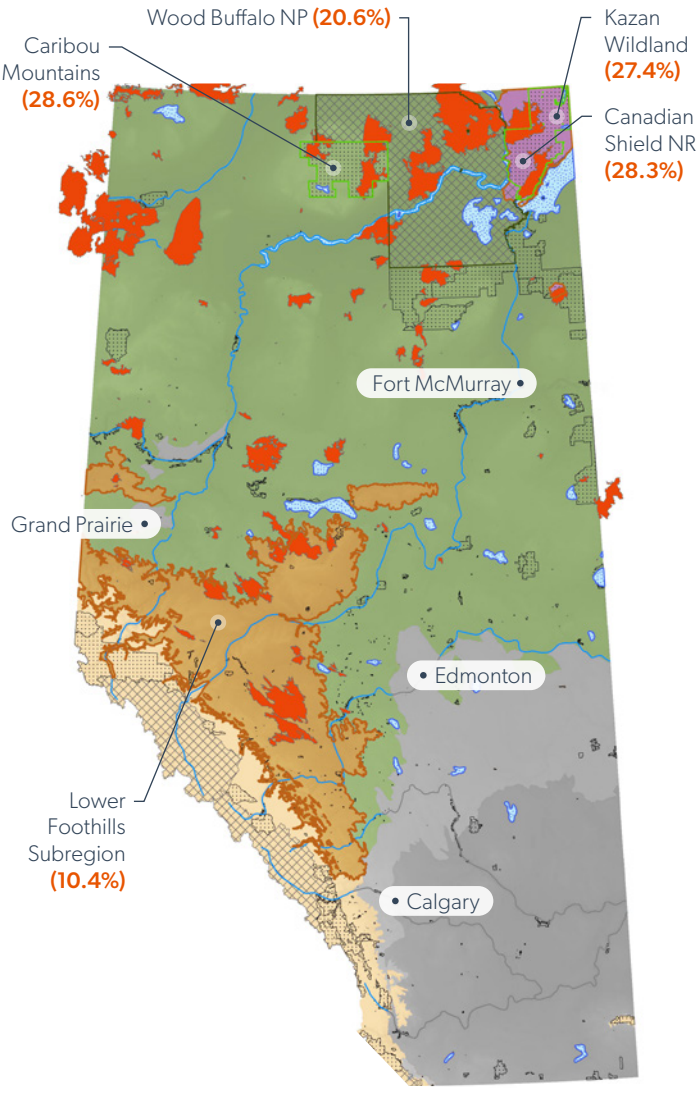

Figure 4

Change in average forest age

Under natural conditions, the overall age of the forest (i.e., the average age of forest stands on the landscape, each of which has been disturbed at different times in the past) stays about the same over time, as the area that burns in a decade is balanced by the aging of stands that do not burn. Sustainable forest management depends on maintaining a distribution of different forest age classes across space and time, and both forestry and wildfire create younger forest on the landscape.

- From 2010 to 2021, average forest age overall in Alberta stayed nearly the same. Some stand types showed moderate decreases in age, including pine, spruce, and mixedwood stands. Treed lowlands and deciduous forests increased in age on average (Figure 5).
- However, the 2023 fires substantially lowered the average forest age. After the fires, all stand types ended up with average ages below their average ages in 2010.
- Treed lowlands (i.e. wooded fens, bogs, and swamps) showed the largest decline, a 6.1-year drop from 2022 to 2023. The drop in average age for pine and spruce added to the declines from 2010 to 2021, making these forest types 8.0 years (pine) and 6.1 years (spruce) younger in 2023 than they were in 2010.
- Declines in average forest age were much greater where there were more fires in 2023. For example, the average age in the Northern Mixedwood natural subregion declined from 68 years in 2010 to 61 years in 2021, then dropped to 47 years after the 2023 fires.
- Regrowth and aging of burned forest starts immediately post-fire, and average forest age varies naturally. However, an increased frequency of extreme fire years with the added effects of human disturbances will drive declines in forest age, representing potential rapid, large-scale and ongoing changes in habitats, and resulting biodiversity which could undermine ecosystem function.

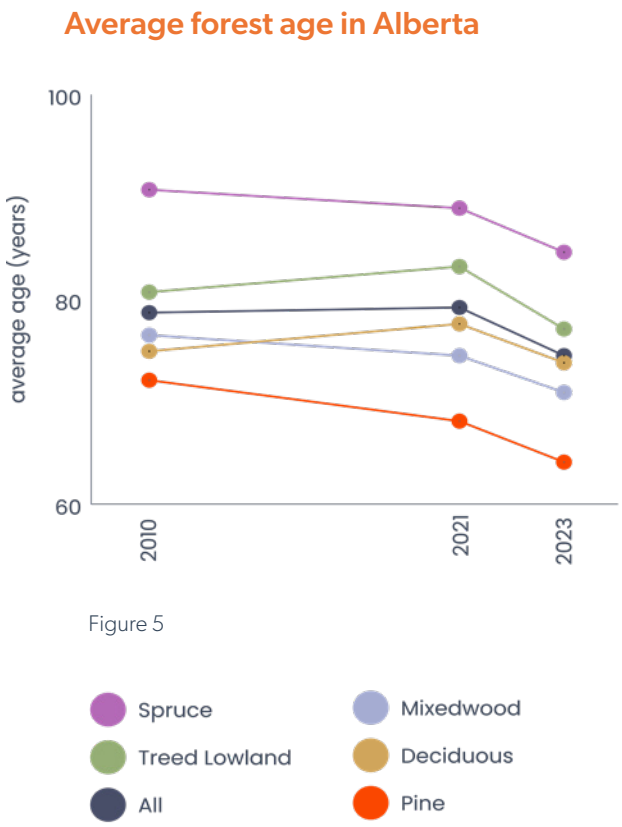

Figure 5

Effects on species

Overall, most lichen, moss, and liverwort species lost habitat in the 2023 fires, while bird, mammal, and plant species showed a mix of increases and decreases (Figure 6).

- Across the whole province, the most negatively affected species lost between 3-6% of their habitat in the 2023 fires. However, in more heavily burned regions like the Canadian Shield and the Northern Mixedwood, about one in eight species lost more than 10% of their habitat. Many of these are species generally associated with old forest or with related features like large trees or snags.
- Because fires were not concentrated in particular habitat types or age classes, impacts were distributed across the province rather than focused on just a few species or communities. Large fires in some areas, like the Northern Mixedwood or Lower Foothills, were offset by few fires in similar habitats in the boreal forest in the eastern part of the province or in the Rocky Mountains. Most species found in north and west-central Alberta have wide ranges extending beyond these heavily impacted areas.

Species at Risk Highlight

Woodland Caribou

Woodland Caribou—a listed species in Alberta—lost 5.2% of their preferred older treed lowland and upland conifer habitat. Losses were higher in the northern caribou ranges, at 13.7% for the Caribou Mountains and 12.7% for the Bistcho herds. Beyond the direct loss of preferred habitat, a possible greater effect on caribou is that shrubs may quickly regrow in some recently burned areas. Shrubs provide food for moose or deer, which in turn feed predators like wolves. Larger populations of predators will put these threatened herds further at risk[6].

[6] Environment and Climate Change Canada. 2020. Amended Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. xiii + 143pp.

Increaser Species

Many species benefit from fire, and a few species that prefer recently burned areas showed large increases in habitat (Figure 6). For burn specialists, recent fires are helping to restore habitat that was reduced for decades by effective fire suppression.

1. Black-backed Woodpecker

The Black-backed Woodpecker is a burn specialist. The highest densities of this woodpecker are in young burned stands where it feeds on insects that live in fire-killed trees. Habitat for this species was predicted to increase by 12.9% in Alberta due to the 2023 fires, and by 38.1% in the Foothills region.

2. Bicknell's Geranium

Bicknell's Geranium is a pretty purple-flowered plant that thrives in burned areas. Its seeds can remain in the soil for decades, germinating when a fire clears away competing plants. The geraniums grow quickly, flower, and set seeds for several years, before other plants take over. The seeds then wait patiently until the next fire comes along. Habitat for this species increased by 22.2% across the province, and by 50% or more in northern and foothills areas.

Decreaser Species

Species associated with old forest lose habitat as a result of wildfires (Figure 6). Habitat for these species improves as mature forests age; there is a large area of mature forest in Alberta that originated in large fires during the Dust Bowl era (1930s), where these species are found. However, if fire years like 2023 become frequent, habitat for old-forest species will decline in the near-term.

3. Boreal Chickadees

Boreal Chickadees live year-round in Alberta forests, using their wits and nearly spherical shape to survive Alberta winters. These resilient birds were predicted to have lost 4.3% of their habitat in Alberta due to the 2023 fires, with losses of 7.5% in the Foothills and up to 23.9% in the Canadian Shield region of Alberta.

4. Clasping Twisted Stalk

Clasping Twisted Stalk, a plant that produces its distinctive red berries in productive old forests, was predicted to have lost 5.8% of its habitat across Alberta, and 8.9% in the Foothills where it is most abundant.

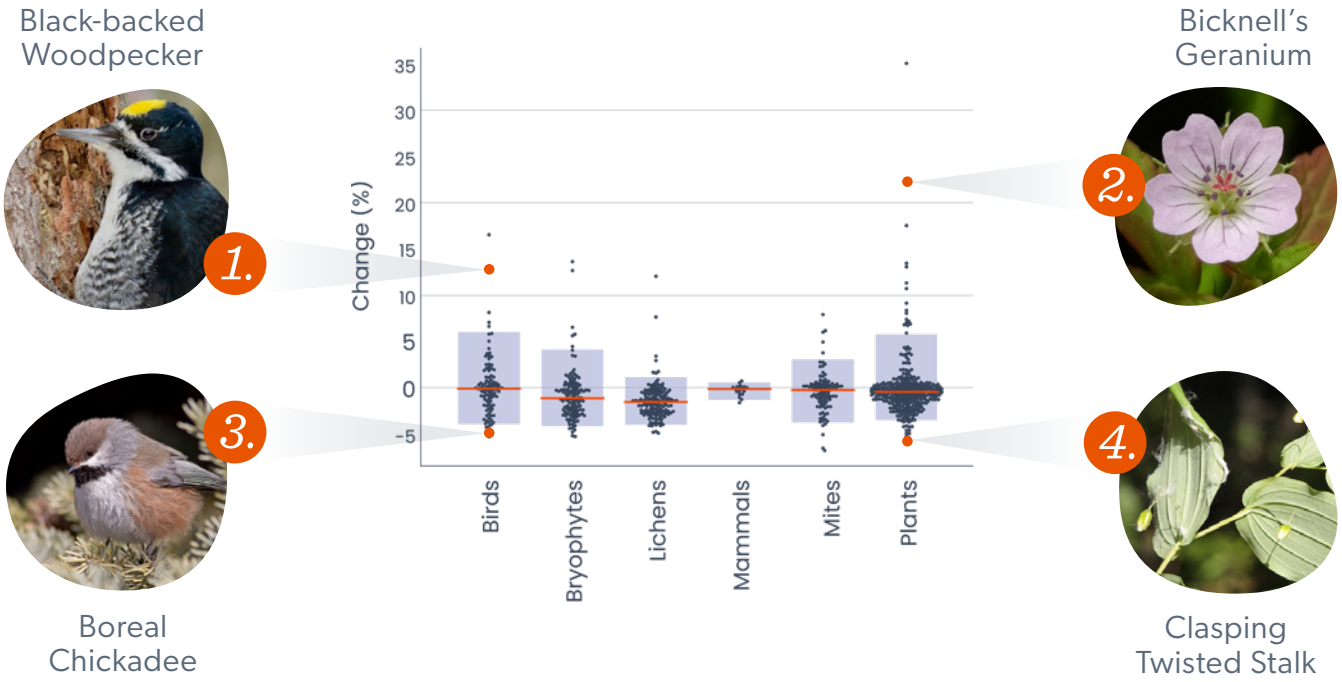

Figure 6. This figure shows the predicted change in abundance (i.e., change in suitable habitat availability) of each modelled species in the six taxa. Each point is a species. The grey rectangle delineates the 5%–95% quantiles. The red line is the median for the taxon. Values below zero indicate species predicted to have decreased in abundance due to the 2023 fires.

Conclusion

By nearly all measures, the year 2023 was a remarkable fire season in terms of area burned compared to fire regimes of the recent past. As a natural process, fire changes habitat conditions that in turn drive changes in species communities in distinct ways. However, as the burned forests begin to regrow, the critical question is whether the fire season of 2023 represents a rare event or whether the coming decades will see more fire years like 2023, particularly in the face of a changing climate. The future of fire, and how land managers and industries respond to it, will determine the sustainability of Alberta's forests in the coming years.

Preferred Citation

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We track changes in wildlife and their habitats across Alberta, working collaboratively to provide ongoing, relevant, and scientifically credible information about our living resources.

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