# Two Centuries of Logging and Road Building have Fragmented Habitat and Reduced Wilderness to 18% in Algonquin Park, Ontario

## *Research Report No. 48*


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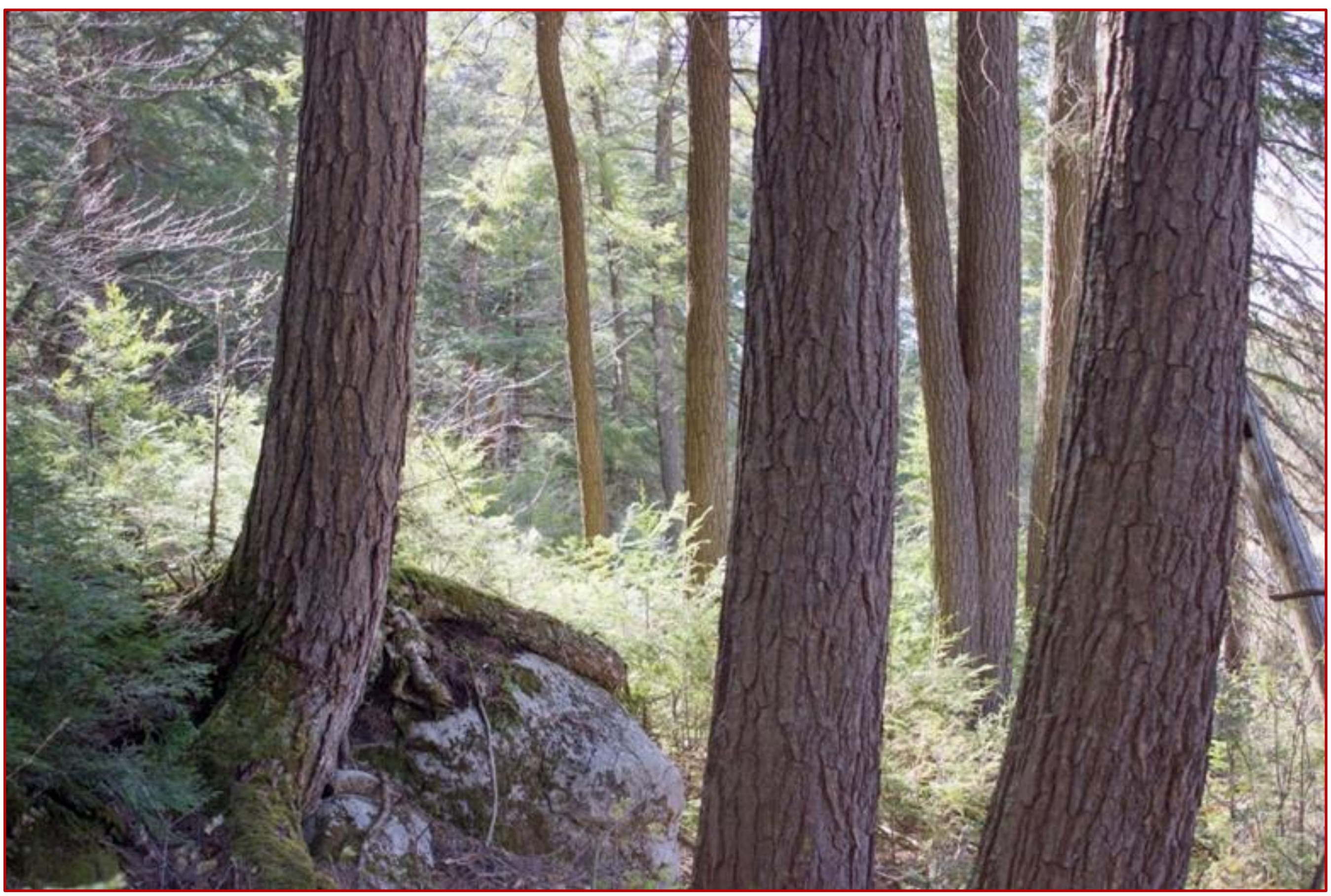


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## Summary

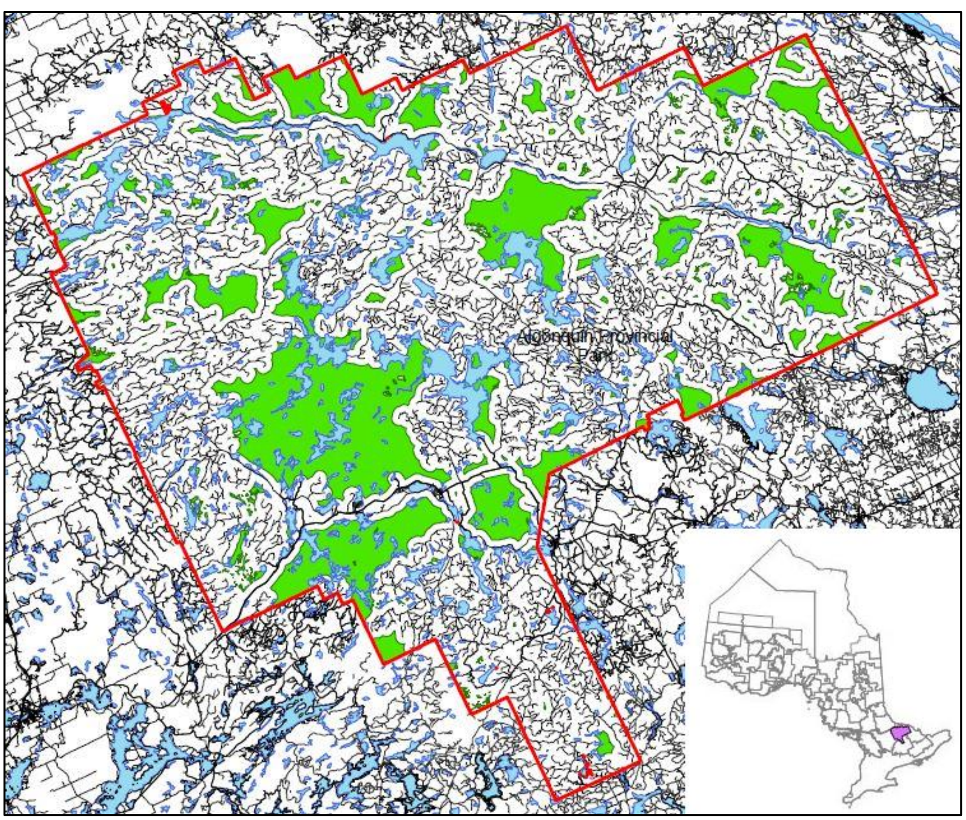
For two centuries, Algonquin Park has been undergoing fragmentation from continuing road building, road use, and forestry activities reducing the Park's original, unlogged, native landscape to 18%. These activities have reduced ecological integrity and wilderness including decline of habitat quality and numerous species, including at least 16 species at-risk. Impacts have affected all trophic levels across numerous species groups and habitats contributing directly to losses of biodiversity and carbon storage. There are at least ~5,500 km of roads that fragment Algonquin Park into 732 roadless areas varying in size from 0.1 ha to 51,327 ha for a total of 136,704 ha covering 18% of the Park's area. Almost 40,000 ha of these roadless areas are unprotected from logging.

Removing logging to restore the Algonquin landscape would result in job losses. However, data suggest that new recreation-tourism jobs would help to offset these losses. In addition to protection of biodiversity and carbon sequestration, and the potential for job increases in recreation-tourism, the removal of logging in the Park would also result in the obsolescence of the Algonquin Forestry Authority. However, this crown corporation could be repurposed into a new agency that would have on-the-ground responsibility to monitor, research, maintain, and restore biodiversity and recreational resources in Algonquin. It could become a scientific hub of field-based, experimental research focussing on biodiversity, ecological integrity, and nature's response to human disturbance that can be applied to develop more productive and less damaging forestry practices outside Algonquin Park.

## Introduction

As Canada's first provincial park and the foundation of the protected areas system in Ontario, Algonquin Park (est. 1893) located in the south-central portion of Ontario, has long been considered Ontario's "flagship" protected area (Ontario Parks Board 2006; Fig. 1). The original legislation that created Algonquin "*allowed for many activities that would now be viewed as incompatible with the purposes of a protected area including: killing wolves, bears and other 'noxious or injurious' wildlife; mining; and logging*" (ECO 2014). After almost 130 years, it is a very different park now than it was in the late 1800s.

**Figure 1 – Roads and Roadless Areas (1 km buffer) in Algonquin Park, Ontario (1 cm = 5 km)**



At ~7,600 $km^2$, it is twice its original size, it receives ~800,000 visitors a year, 65% (2,647 $km^2$) is available for logging (IUCN 2022), and it is criss-crossed by at least 5,500 km of roads (primarily for logging). These roads, if arranged end to end, would stretch across the entire U.S.A. from Maine to San Francisco. Although culling of top predators and mining, except for gravel, are no longer permitted, the continuation of logging since ~1830 (192 years) has led to a reduction in ecological integrity and wilderness values including the decline of habitat quality and numerous species (Quinn 2004, Quinn 2005), including 16 species at-risk.

It is the only park in Ontario that allows logging and is one of only two provincial or national parks in Canada where logging is allowed - Duck Mountain Provincial Park in Manitoba is the other. Algonquin's biodiversity decline is just one example of what is happening throughout the world – "*seventy-five per cent of the Earth's ice-free land surface has already been significantly altered, most of the oceans are polluted, and more than 85% of the area of [original] wetlands has been lost*" (Currie et al. 2020).

A recent study of a large area (~130,000 $km^2$) of eastern Canada's Acadian Forest found that forestry activities resulted in the loss of breeding bird habitat for 66% of the 54 most common bird species between 1985 and 2020. This habitat loss was strongly associated with the reduction of old-growth forests, which resulted in declines of bird species that rely, at least partially, on this forest condition (Betts et al. 2022). This potentially catastrophic trend of declining global ecological health emphasizes the absolute need to create and maintain intact parks and nature reserves for the ecological services they provide to humanity now and into the future, among numerous other values (Henry and Quinby 2021).

In Algonquin Park, 13 tree species began to decline at some point after ~1830 when logging started in the Park. They include American elm (Leadbitter 2002), basswood (Leadbitter 2002), black cherry (Leadbitter 2002), eastern hemlock (AESL 2009), eastern white pine (Quinn 2004, Thompson et al. 2006), jack pine (Cumming 2005), larch/tamarack (Pinto et al. 2006), northern white cedar (Pinto et al. 2006), red oak (Leadbitter 2002, Cumming 2005), red pine (AESL 2009, Pinto et al. 2008), red spruce (Anderson and Gordon 1990), white cedar (Pinto et al. 2006), and yellow birch (Vasiliauskas 1995, Pinto et al. 2006).

These declines, in association with other environmental impacts of logging, have contributed to habitat changes resulting in negative impacts on bird species including barred owl (AESL 2010), blackburnian warbler (AESL 2010), black-throated blue warbler (Jobes et al. 2004), brown creeper (Geleynse et al. 2015), oven bird (Jobes et al. 2004), parula warbler (AESL 2010), red-shouldered hawk (Naylor et al. 2004), saw-whet owl (AESL 2010), white-winged crossbill (AESL 2010), wood thrush (AESL 2010) and yellow-bellied sapsucker (Jobes et al. 2004). Additional negative impacts to species due to logging activity in the Park have been documented for wolves (Benson et al. 2015), moose (McLaughlin et al. 2011), beaver (Quinn 2005, AESL 2010), bees (Nol et al. 2006, Nardone 2013), hoverflies (Nol et al. 2006), and click beetles (Nol et al. 2006).

Assessing forest habitat changes in Algonquin since pre-settlement, Quinn (2004) found: (1) loss of conifer tree cover, (2) alteration of forest canopy gap size, (3) qualitative changes in coarse woody debris, (4) reductions in forest stand basal area, (5) a decrease in super-canopy trees, and (6) reduced early successional riparian (beaver) habitat. Focussing on historical changes in eastern white pine in Algonquin Park, Thompson et al. (2006) found that tree density declined by 88%, stand area declined by 40%, and mean diameter declined 61% from 73.4 cm to 44.5 cm. Finally, more than 200 alien plants have been introduced into the Park by humans, the gypsy moth has been transported to Algonquin's rare red oak stands on vehicles using logging roads, and fishing access to interior lakes via logging roads has resulted in the introduction of the alien rusty crayfish from the United States (Mead et al. 2000).

These and other impacts to biodiversity have been occurring in Algonquin Park for almost two centuries due in large part to road construction, road use, and forestry activities that have penetrated all trophic levels ranging across numerous species groups and habitat types contributing directly to losses of biodiversity, carbon storage (e.g., decline of eastern white pine), and wilderness (1+ km from a road). However, the extent and location of these impacts has never been determined for the Park.

Thus, the purpose of this study was: (1) to conduct an assessment of roadless areas (RAs) as an indicator of wilderness in Algonquin Park, (2) to determine RA conservation status, (3) to map RAs, (4) to compare and contrast RAs in Algonquin to RAs in an adjacent unprotected region, and (5) to address the future of biodiversity and ecological integrity in Algonquin. To meet the federal goal of protecting 30% of lands and waters by 2030 (30 x 30 Strategy; Jetz et al. 2021), the Ontario government must protect ~20 million ha in the next nine years. This should begin by immediately protecting unprotected areas within existing parks and reserves – "*biodiversity conservation is more than an ethical commitment for humanity: it is a non-negotiable and strategic investment to preserve our health, wealth and security*" (Currie et al. 2020).

## Methods

Using the GIS software program ArcMap (10.8.1) and data from Ontario GeoHub, human-related linear corridors limited to primary, secondary, and tertiary roads (includes logging roads); all railroads; and all hydro-corridor roads, were buffered by 1 km (e.g., Davidson et al. 2000, Ibisch et al. (2016), Potapov et al. (2017). Since the Ontario Road Network dataset provided only 215 km of roads in Algonquin, presumably because it is designated as a park, additional digital roads data were required to adequately characterize this metric within the entire Park. Supplemental roads data were obtained from the Algonquin Forestry Authority, the Wilderness Committee-Ontario, and Ancient Forest Exploration & Research. We refer to all these buffered corridors as "roads" in the remainder of this paper. Trails and portages were not buffered.

Forest Resources Inventory (FRI 2007) data were used to identify previously logged areas and were added to the buffered areas. Roads data were obtained from the Ontario Road Network and the Ministry of Natural Resources and Forestry (MNRF) Road Network dataset (available for the Georgian Bay-Lake Nipissing (GBLN) region only). Railway data came from the Ontario Railway Network dataset. All areas not included within the 1-km buffered areas were defined as roadless areas (RAs) (e.g., Davidson et al. 1999, Ibisch et al. 2016, Potapov et al. 2017).

To create a comparative region (GBLN) near and similar in size to Algonquin Park that occupied roughly the same latitudinal coordinates, boundaries of the Georgian Bay Fringe region (GBBR 2018) were modified prior to running RA GIS analyses. This was accomplished by: (1) shifting the Georgian Bay Fringe area boundaries northward to approximate the latitude of Algonquin, (2) leaving the western boundary located along the Lake Huron coastline and moving the eastern boundary further eastward to achieve a size similar to the Park, (3) increasing the size from ~622,500 to 762,265 ha to closely match the 761,046 ha size of Algonquin, and (4) adjusting the eastern boundary of the GBLN region to run roughly parallel to Highway 11, which is a four-lane, super highway running north-south that separates the two regions.

## Results

We found at least ~5,500 km of roads that fragment Algonquin Park into 732 RAs (Fig. 1) varying in size from 0.1 ha to 51,327 ha for a total of 136,704 ha covering 18% of the Park's area (Table 1). This amount is slightly less (by 300 km) than the 5,800 km of roads in Algonquin Park reported by Wedeles (2009). The highest concentration of RAs in Algonquin is in the central portion of the west side (Fig. 1). On that side, very little RA cover is found along the western border and in the southern pan-handle areas. On the east side of the Park, the largest RA surrounds Lake Lavieille, and two other mid-sized RAs are located a few km southeast of the Lake. Five mid-sized RAs are scattered along the northern Park boundary and numerous other small RAs are distributed primarily throughout the northern portion of the Park.

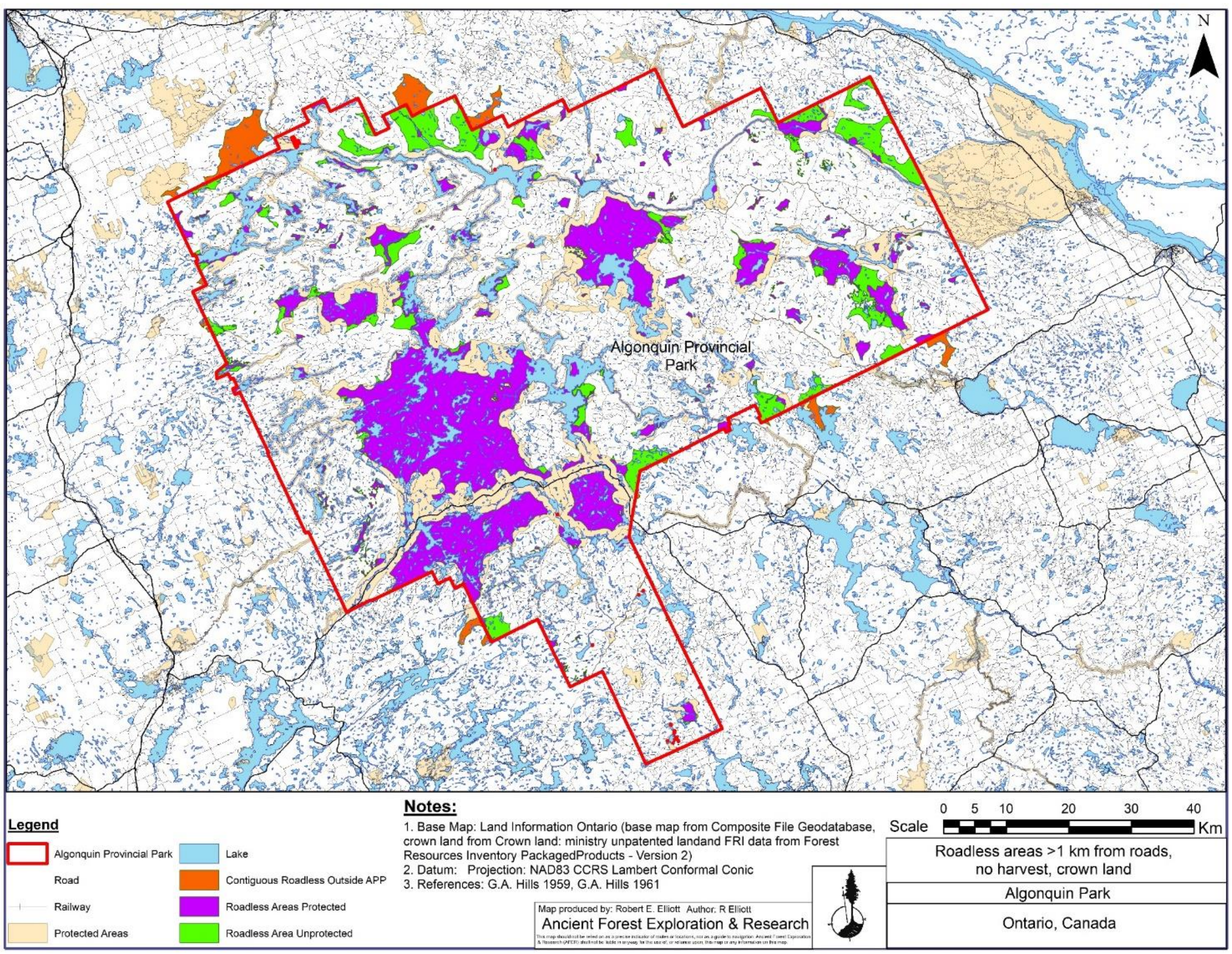
Of the RAs, 568 are smaller than 10 ha, 164 are larger than 10 ha, 34 are larger than 400 ha, three are larger than 10,000 ha, and one is larger than 50,000 ha. The two largest RAs are located adjacent to Highway 60, one to the north (51,327 ha), which is ~99% protected, and one to the south (16,721 ha), which is completely protected. The RA adjacent to the northern and eastern shores of Lake Lavieille near the center of the Park is the third largest RA at 15,892 ha and is mostly protected. Despite Algonquin's "park" status, many RAs there remain available for logging. Of the 136,704 ha of RAs in the Park, 39,854 ha (29%) are unprotected; of the 34 RAs greater than 400 ha, 21 are not protected; and of the 698 RAs less than 400 ha, 524 are unprotected (Fig. 2).

**Table 1 – Comparing Roadless Area Metrics in Algonquin Park with those in the Georgian Bay-Lake Nipissing Region**

| Region | Total Area (ha) | Total Area Protected (ha) | Total RA* (ha) | RA Protected (ha) | RA Unprotected (ha) |
|---|---|---|---|---|---|
| **Algonquin Park (AP)** | 761,046 | 175,150 (23%) | 136,704 (18%) | 96,848 (13%) | 39,854 (5%) |
| **Georgian Bay-Lake Nipissing (GBLN)** | 762,265 | 165,944 (22%) | 216,692 (28%) | 71,037 (9%) | 145,654 (19%) |
| **Difference** | 1,219 (+GBLN) | 9,206 (+AP) | **79,988 (+GBLN)** | 25,811 (+AP) | 105,800 (+GBLN) |

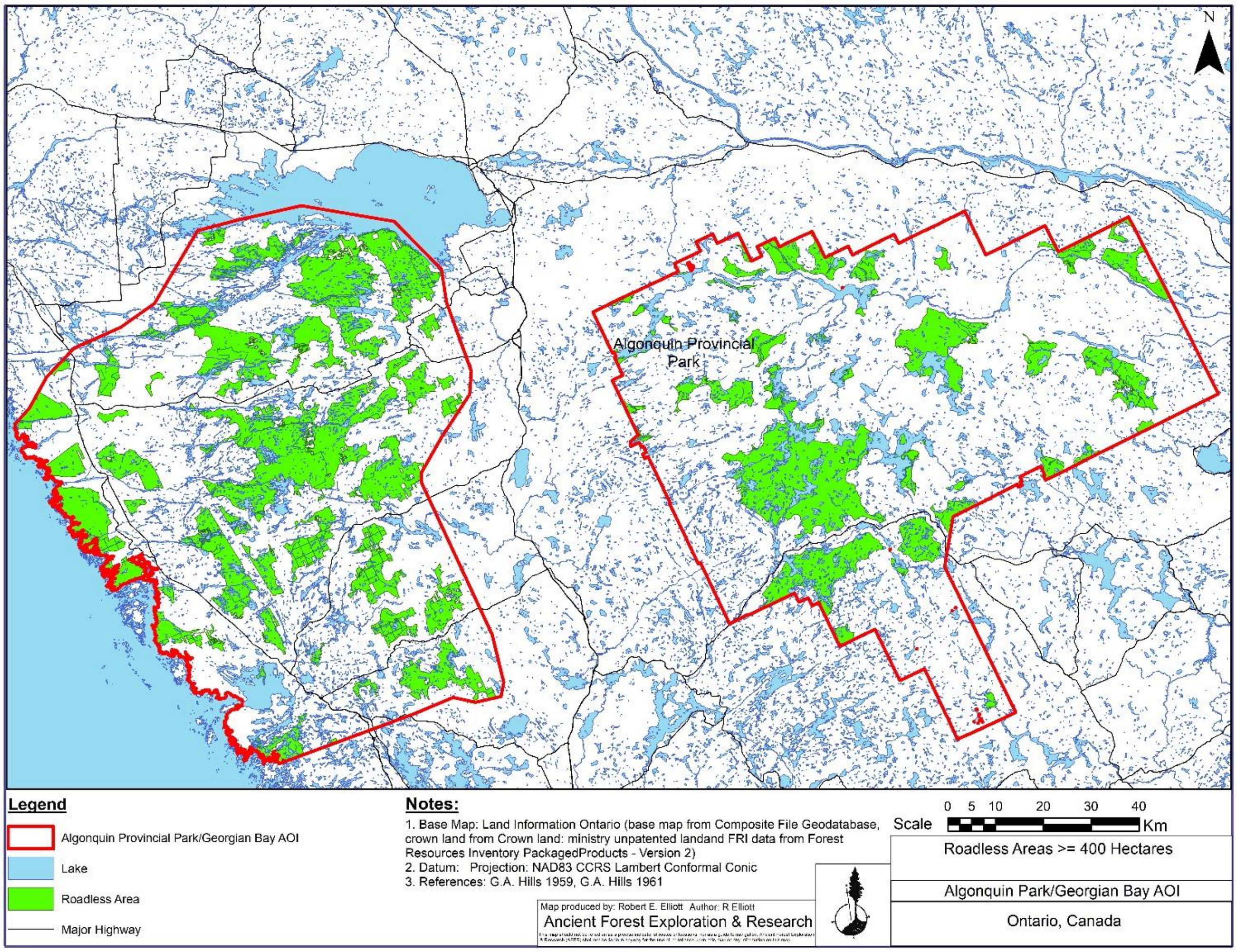
* RA = roadless area, defined as all areas 1 km from a road (primary, secondary, tertiary) with no minimum size for this table

**Figure 2 – Protected and Unprotected Roadless Areas in Algonquin Park**



When compared with the nearby, similar-sized GBLN region (Fig. 3), Algonquin Park falls short by 80,000 ha with 136,704 ha (18% of the Park) of RA compared with 216,692 ha (28%) in the GBLN region (Table 1). There are a number of factors that may have contributed to less disturbance from roads and forestry in the GBLN region: (1) logging for white pine square timbers in the GBLN region started about 30 years after it began in Algonquin Park (Scott 2018), (2) the railway in the GBLN region was not established until about 20 years after the railway was built in Algonquin (Scott 2018), and (3) the productivity of the forests in the GBLN region is generally lower than in the Park due to thin soils and a relatively high abundance and cover of rock barrens (Remmel 2009, GBLT 2019).

**Figure 3 - Roadless Areas in Algonquin Park (east) and in the Georgian Bay-Lake Nipissing Region (west)**




Thus, the GBLN forests are generally less desired by forest industry since larger areas must be logged to remove the same amount of biomass compared with forests in Algonquin Park, which on average are more productive. Although RAs are much more abundant in the GBLN region, only 33% of RA cover in the GBLN region is protected compared with 73% protection for RA cover in the Park.

## Discussion

For almost two centuries, Algonquin Park has been undergoing forest landscape fragmentation primarily because of road building, road use, and forestry activities degrading the Park's original, native habitat to 18% of the Park area, which continues with no end in sight. Even a nearby region of similar size (GBLN region) that is not designated as a park has upwards of 80,000 ha more RA than Algonquin. Clearly, with 65% of the Park available for logging, resource extraction is the central management principle for Algonquin, which has been managed more like a working (logged) "provincial forest" than a "provincial park". In contrast and as described by legislation (Parks and Conservation Reserves Act 2020), parks in Ontario are places where ecological integrity is prioritized as the central management principle.

The U.S. Forest Service manages much of its 193 million acres in the same multiple-use fashion (with logging) as Algonquin, designating the individual units as "National Forests" (USFS 2022), e.g., *Sequoia National Forest*. Algonquin Park could be re-designated "Algonquin Provincial Forest", which would be a much more accurate functional description, however, that would also contravene the 30 x 30 Strategy. To reach the goal of protecting 30% of Ontario's lands and waters by adding 20 million ha by 2030, we should begin by protecting unprotected portions within existing parks and conservation reserves.

If Algonquin Park is to be restored, logging would need to be removed (Mead et al. 2000), however, due to its current value to the economies of local communities, this regulation change has not yet been seriously considered. This is despite some relevant economic data for the Park and surrounding region relating to tourism and recreation (Bowman 2001), and other industries including forestry (Mead et al. 2000). These data suggest that development of recreation-based tourism has the potential to contribute a large portion of new jobs that could replace at least a portion of the jobs lost from removing logging from the Park. For example, Bowman (2001) estimated that annual visitor spending during 1999 and 2000 in the Algonquin Park area was approximately $20 million – $8 million in labour income, $12 million in gross domestic product – and supported 300 local jobs. If additional recreational resources in and adjacent to Algonquin were developed in the absence of logging, the economic benefits could be expanded and increased significantly (Mead et al. 2000).

Finally, the Algonquin Forestry Authority (AFA), a provincial crown corporation that manages logging in the Park, would become obsolete if logging ceased there. However, the AFA could be repurposed into the "Algonquin Biodiversity and Recreation Authority" (ABRA) that would have on-the-ground responsibility to monitor, research (including outreach), maintain, and restore biodiversity and recreational resources in Algonquin. Given the two centuries of logging within a myriad of forest community types throughout the Park, ABRA could become a scientific hub of field-based, experimental research focussing on biodiversity, ecological integrity, and nature's response to human disturbance, particularly logging.

With a long history of field research in the natural sciences (at least 80 yrs.), three field stations (Opeongo Harkness Fisheries Lab, Lake Sasajewun Wildlife Lab, and the Swan Lake Forest Ecology and Silviculture Lab), and thousands of publications, Algonquin Park is well-positioned for further research development to address critical natural resource issues at all scales from local to global (AWRS 2022). For example, results from forest ecology studies in the Park (e.g., Quinby 1988, Thompson et al. 2006) could be applied to improving forest regeneration and tree growth in managed forest stands outside of Algonquin resulting in silvicultural and harvesting techniques that are more productive and more sustainable. Thus, in addition to job creation in recreation and tourism, some applied research programs could also have positive economic spin-offs that would contribute to the offset of forestry job losses in the Park.

## Conclusions

1. At least ~5,500 km of roads fragment Algonquin Park into 732 RAs varying in size from 0.1 ha to 51,327 ha for a total of 136,704 ha covering 18% of the Park's area. Almost 40,000 ha of these RAs are unprotected from logging.

2. RAs compose 28% of the nearby Georgian Bay-Lake Nipissing region, which is not a park and is roughly equal to the size of Algonquin. This represents 80,000 ha more RA than in Algonquin Park.

3. The relatively low ecological integrity of Algonquin Park due to resource extraction that continues to exploit primary forested landscapes (e.g., old-growth forests) contradicts the legislative requirement to maintain and restore the "ecological integrity" of parks and conservation reserves.

4.  If Algonquin Park is to be restored, logging must be removed, which would result in the loss of local jobs. However, economic data suggest that expansion of recreation-based tourism in and around the Park has the potential to contribute a significant number of new jobs that would help to offset job losses.  Further studies are required to address this potential.

5.  The removal of logging in the Park would also result in the obsolescence of the Algonquin Forestry Authority, however, this crown corporation could be repurposed into the Algonquin Biodiversity and Recreation Authority.  The new agency would have on-the-ground responsibility to monitor, research, maintain, and restore biodiversity and recreational resources in Algonquin and could become a scientific hub of field-based, experimental research focussing on biodiversity, ecological integrity, and nature's response to human disturbance that can be applied to develop more productive and less damaging forestry practices outside the Park.  Expanding and operating ABRA research and management programs could also contribute to offsetting forestry job losses.

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