Benefits of Restoration (logging removal) in Algonquin Park: Old-growth Forest Ecology and Roadless Areas as Candidate Reserves

Wildlands League Workshop, Dec. 1-2, 2025

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Ancient Forest Exploration & Research

(remote presentation)

Outline

1. **Review**: "*Vegetation, Environment, and Disturbance in the Upland Forested Landscape of Algonquin Park, Ontario*"; Ph.D. Thesis; U of T; P. Quinby (1988)

2. **Review**: "*A Predictive Model for Upland Forest Community Composition in Algonquin Park, Ontario*"; AFER Report (FLB#4); P. Quinby (1993)

3. **Review**: "*Ecological Decline and Roadless Habitat Restoration after Two Centuries of Multiple-Use Management in Algonquin Park, Ontario, Canada*"; *Biosphere* (journal, in press); P. Quinby

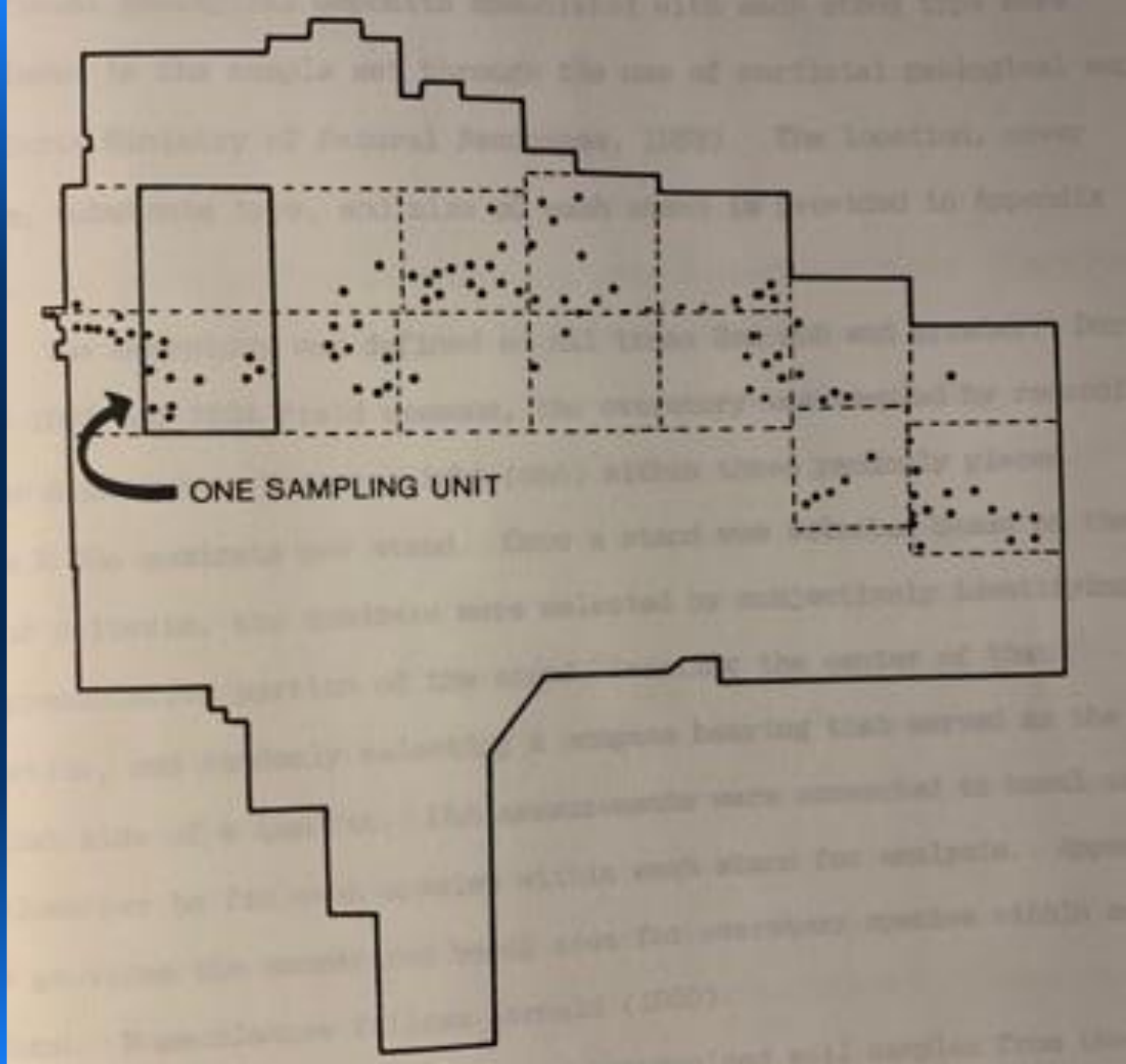
Influence of Habitat and Fire on Upland Old-growth Forests in Algonquin Park, Ontario (Ph.D. Thesis)

1. Index of fire incidence (probability of burning)

2. Relationships between understory plant composition and habitat conditions including fire

3. Relationships between overstory tree composition and habitat conditions including fire – **my focus today**
    a. primary influence: “fire-soil moisture complex gradient”
    b. these two variables are inversely related
    c. fire has the greatest influence

Sampled Old-growth Stands (100) in Algonquin Park



Mean Stand Basal Area for Overstory Species (23) by Forest Dominance Type (9)

MAJOR SPECIES	DOMINANCE TYPE								
	hemlock	yellow birch	sugar maple	white birch	red oak	poplar	white pine	red pine	jack pine
Tsuga canadensis	44.36	3.98	1.51			.02			
Betula lutea	1.35	34.52	4.13	.03		.07	.05		
Acer saccharum	2.41	8.68	25.85	3.69	.16	1.66	.40		
Fagus grandifolia	.01	.16	1.35	.48	.61	.08	.05		
Abies balsamea	.56	.38	.33	13.15		.56	.79	.63	
Acer rubrum	.96	.64	.61	1.33	1.04	1.66	.89	.17	
Betula papyrifera	.54	.31	.52	17.69	.12	1.39	1.22	.10	
Picea glauca	.01	.22	.32	.55	.09	1.18	1.54	.21	.21
Quercus rubra			.25	.57	18.33	.25	1.22		
Populus grandidentata			.07	.38	1.39	26.55	3.27	3.43	
Pinus strobus			.34	.75	5.52	4.43	27.48	7.10	1.13
Populus tremuloides			.13		.63	2.81	2.00	2.37	3.57
Pinus resinosa			.01	.04	.01	2.27	2.29	27.48	2.21
Pinus banksiana				1.90		.09	.22	1.50	17.32
MINOR SPECIES (< 1% relative basal area)									
Prunus serotina			.12			.01			
Tilia americana			.37				.03		
Fraxinus nigra		.03	.01				.01		
Ostrya virginiana			.17	.20	.26	.05	.07		
Thuja occidentalis	.39	1.01	.03		.42	.08	.28	.01	
Acer pennsylvanicum	.15		.04	.04	.02	.10	.06		
Alnus rugosa						.01			
Acer spicatum						.01	.01		
Picea mariana					.04	.01	.01	.06	.13
No. of stands	4	5	40	3	3	19	19	5	2
Mean basal area (m^2/ha)	50.74	49.93	36.16	40.80	28.64	43.29	44.65	43.06	24.57

Biomass Calcs: https://apps-scf-cfs.rncan.gc.ca/calc/en/biomass-calculator
Carbon Calcs: .5 x biomass

STAND DOMINANCE TYPES (100 stands; 300 plots)	ABOVE-GROUND BIOMASS (tonnes/ha)					CARBON (tonnes/ ha)
	Bark	Branches	Foliage	Wood	Total	
white birch (3; 9)	96,198	238,249	2,262	820,649	1,157	579
red pine (5; 15)	14,600	258,388	18,366	592,337	884	442
poplar (19; 57)	74,620	195,418	4,899	511,010	786	393
yellow birch (5; 15)	63,807	288,973	1,268	350,149	704	352
eastern hemlock (4; 12)	80,868	82,573	6,713	514,845	685	342
red oak (3; 9)	26,182	455,524	1,685	180,135	664	332
sugar maple (40; 120)	17,732	174,186	2,448	466,300	661	330
white pine (19; 57)	42,125	172,844	10,709	342,105	568	284
jack pine (2; 6)	8,995	34,262	2,195	325,111	371	185

Location	Forest Type – NE North America	Above-ground Carbon in Live Biomass (t/ha)	Reference
Algonquin Park, ON	Old-growth *Betula papyrifera* Forest	579	*This Study*
Michigan, USA	Old-growth *Tsuga canadensis* Forest	453	Woods (2014)
Michigan, USA	Old-growth *Acer saccharum* Forest	442	Woods (2014)
Algonquin Park, ON	Old-growth *Pinus resinosa* Forest	442	*This Study*
Algonquin Park, ON	Old-growth *Populus* Forest Forest	393	*This Study*
Algonquin Park, ON	Old-growth *Betula allegheniensis* Forest	352	*This Study*
Algonquin Park, ON	Old-growth *Tsuga canadensis* Forest	342	*This Study*
Michigan, USA	Old-growth Mixed Hardwood-Conifer Forest	339	Woods (2014)
Algonquin Park, ON	Old-growth *Quercus rubra* Forest	332	*This Study*
Algonquin Park, ON	Old-growth *Acer saccharum* Forest	330	*This Study*
Algonquin Park, ON	Old-growth *Pinus strobus* Forest	284	*This Study*
Algonquin Park, ON	Old-growth *Pinus banksiana* Forest	185	*This Study*
Mid-Atlantic US	Old-growth *Quercus alba (Quercus prinus, Liriodendron tulipifera, Tsuga canadensis, Acer saccharum, Quercus rubra)*	154	McGarey et al (2015)

Location	Forest Type	Above-ground Carbon in Live Biomass (t/ha)	Reference
Vermont, USA	Old-growth *Acer saccharum (Fraxinus americana)*	139	Burrascano et al (2013)
West Catchacoma Forest, ON	Old-growth *Tsuga canadensis*	136	Marcus (2023)
Maine/New Hampshire, USA	Old-growth *Tsuga canadensis (Picea* sp., *Albies* sp.*)*	132	Burrascano et al (2013)
Michigan, USA	Old-Growth *Acer saccharum (Betula alleghaniensis, Tsuga canadensis)*	131	Burrascano et al (2013)
Panuke Lake, Nova Scotia	Old-growth *Tsuga canadensis (Picea rubens)*	116	Stewart et al (2003)
Michigan, USA	Mature *Acer saccharum (Betula alleghaniensis, Tsuga canadensis)*	115	Burrascano et al (2013)
Sporting Lake, Nova Scotia	Old-Growth *Tsuga canadensis (Pinus strobus, Picea rubens)*	111	Stewart et al (2003)
Vermont, USA	Old-growth *Tsuga canadensis (Picea* sp., *Abies* sp.*)*	111	Burrascano et al (2013)
Maine/New Hampshire, USA	Old-Growth *Acer saccharum (Fagus grandifolia, Betula* sp.pl.*)*	104	Burrascano et al (2013)
Grand Anse, Nova Scotia	Old-growth *Acer saccharum (Betula alleghaniensis, Acer rubrum)*	104	Stewart et al (2003)

Forest Landscape Baselines NO. 4

Brief Progress and Summary Reports 1993

A PREDICTIVE MODEL FOR UPLAND FOREST COMMUNITY COMPOSITION IN ALGONQUIN PARK, ONTARIO

Peter A. Quinby

Multiple Regression Analysis

Using Ph.D. Thesis Data

DCA-axis1 Score = 1049 + (884.6 x $\log_{10}$ *fire*) – (.2948 x *precip.*) + (.9666 x *%sand*) + (251.4 x *dum*)

(n=81; R^2=.92; F=215; p<.001)

- To obtain homogeneous stand score segments on DCA axis 1, two forest dominance types were lost (*red oak & white birch*)
- DCA Axis 1 explains 87.5% of overstory spp. variation
- 83% mean classification accuracy (81 stands)

Community Type	Classification (DCA axis 1 scores)	% Predicted Correctly
hemlock (*Tsuga canadensis* (L.) Carr.)	0 to 54 (4 stands)	100
yellow birch (*Betula lutea* Michx. f.)	55 to 110 (5 stands)	80
sugar maple (*Acer saccharum* Marsh.)	111 to 276 (37 stands)	89
poplar (*Populus grandidentata* Michx. and *P. tremuloides* Michx.)	277 to 399 (14 stands)	100
white pine (*Pinus strobus* L.)	400 to 466 (14 stands)	57
red pine (*Pinus resinosa* Ait.)	467 to 575 (5 stands)	80
jack pine (*Pinus banksiana* Lamb.)	576 to 596 (2 stands)	0
ALL		83

Classification of Upland Forest Dominance Types (7) Based on DCA Axis 1 Scores for 81 Old-growth Stands, Algonquin Park, Ontario

Jack pine

Red Pine

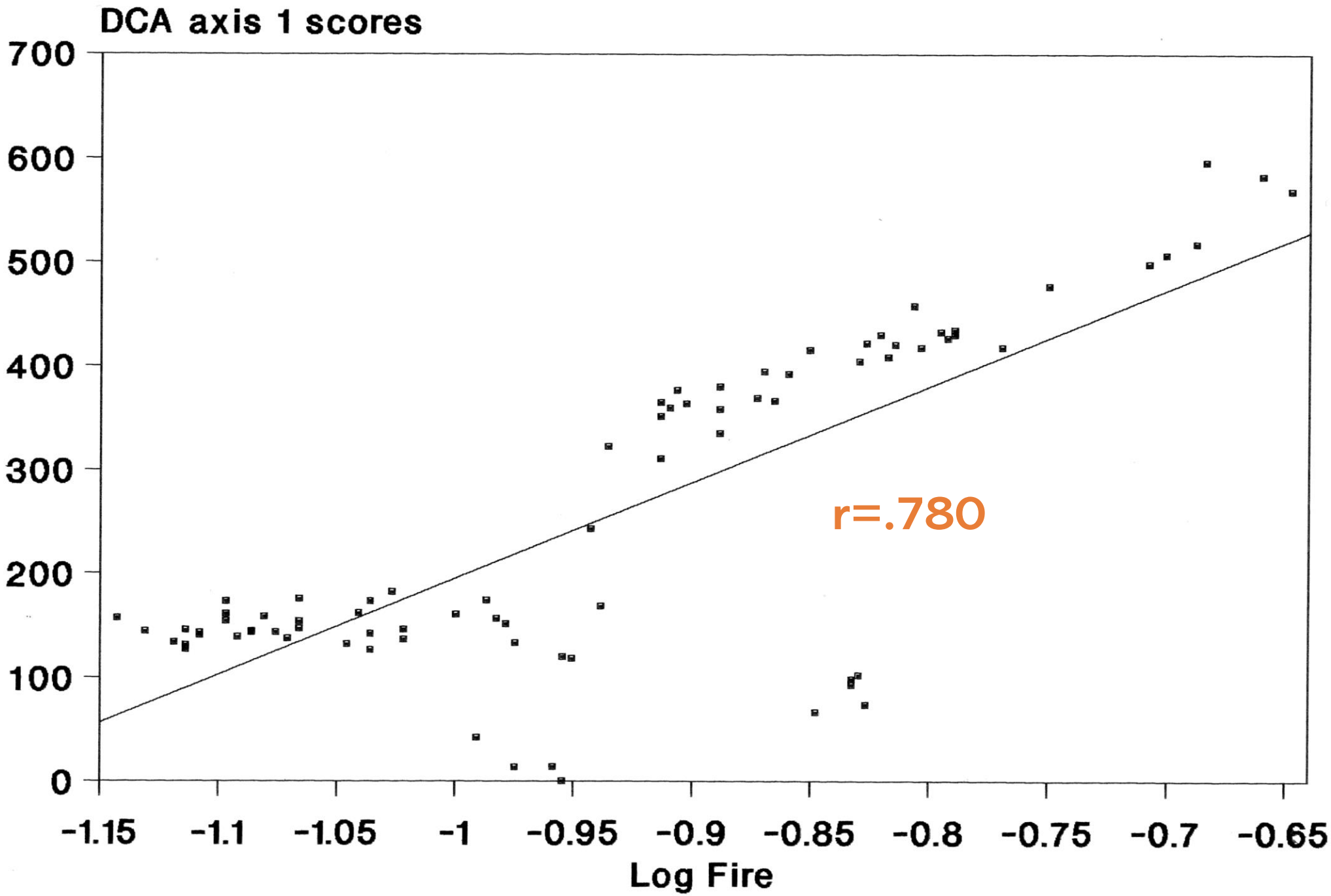
White Pine

Poplar

Sugar Maple

Yellow Birch

Hemlock



Jack pine

Red Pine

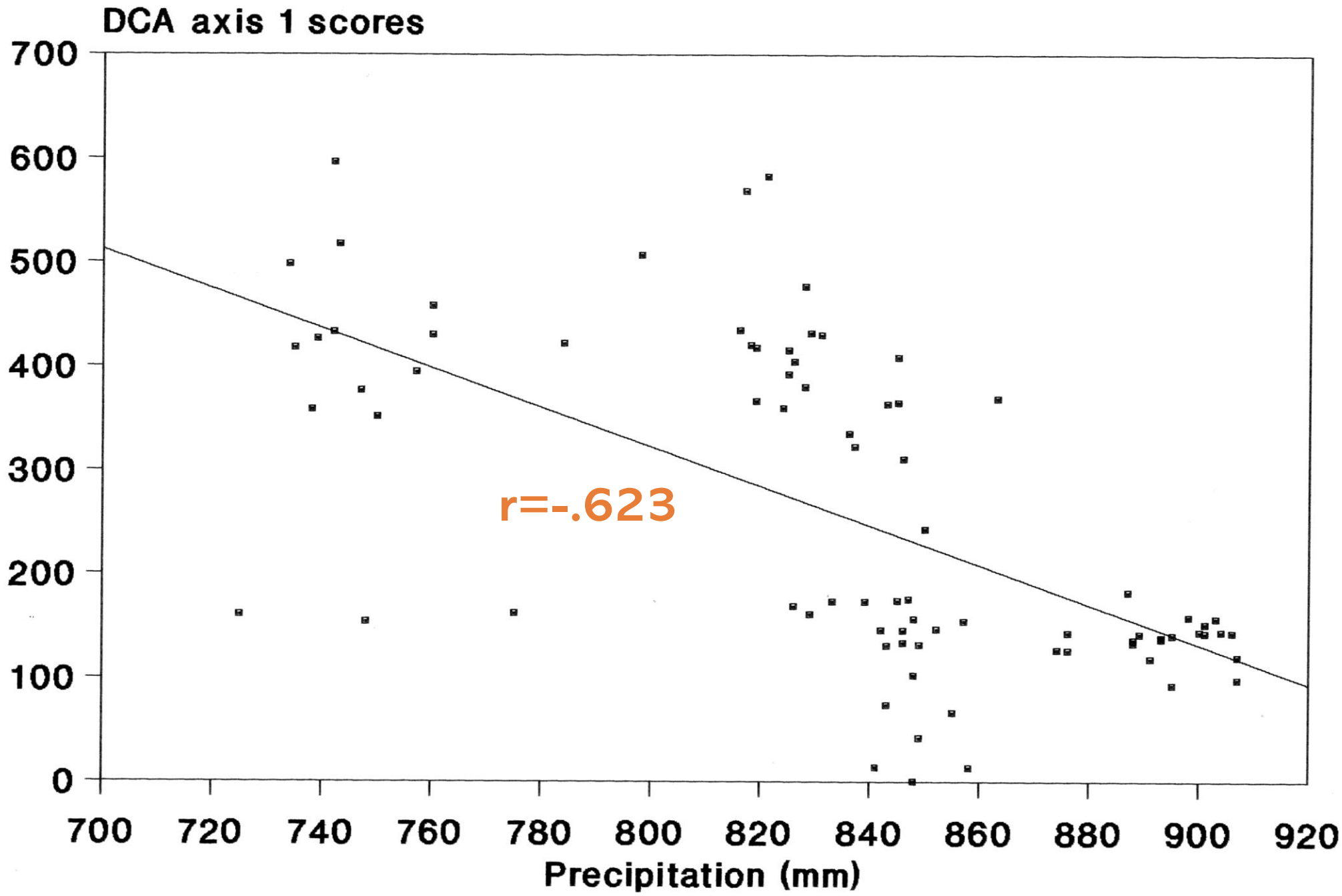
White Pine

Poplar

Sugar Maple

Yellow Birch

Hemlock



Jack pine

Red Pine

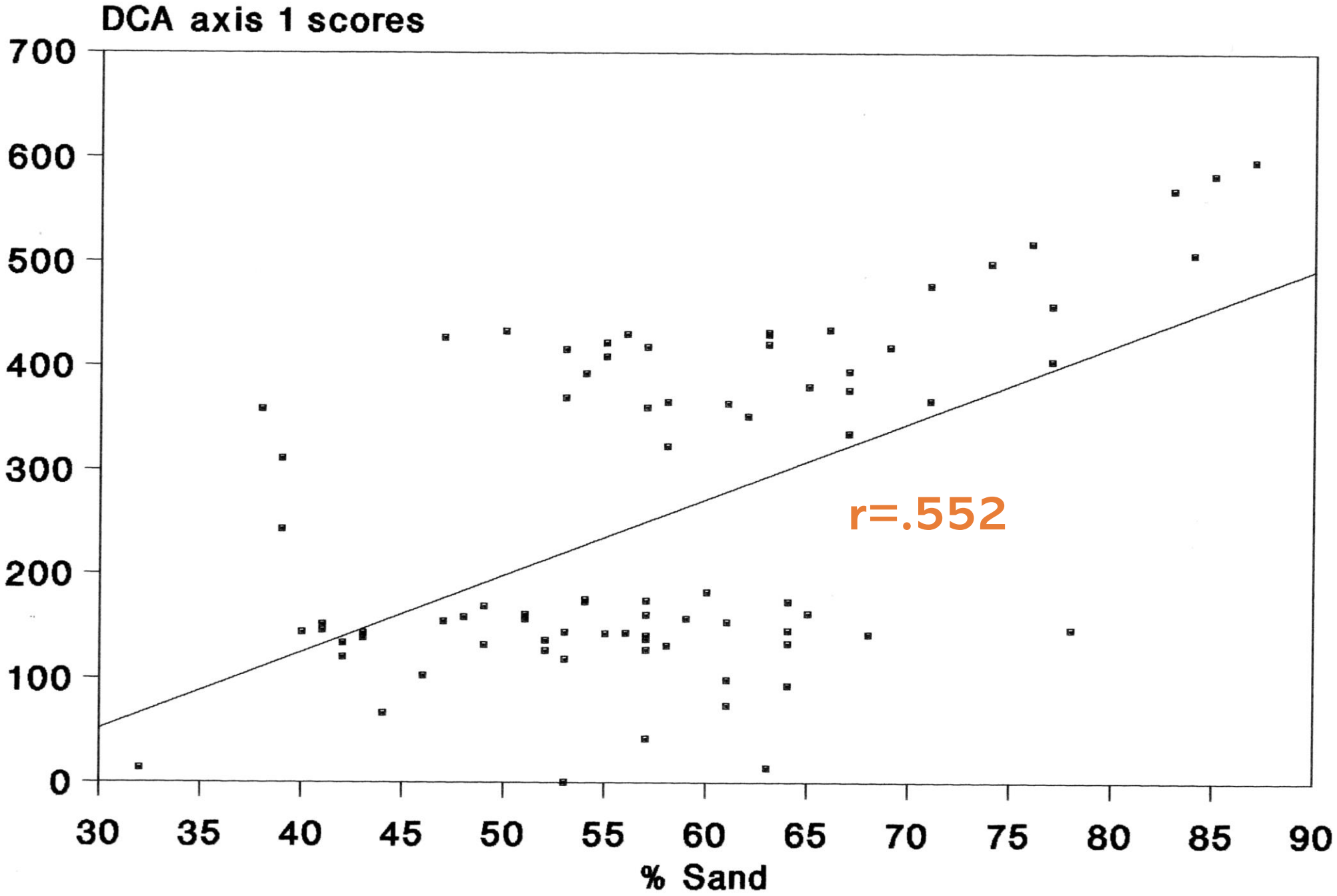
White Pine

Poplar

Sugar Maple

Yellow Birch

Hemlock



Article

Ecological Decline and Roadless Habitat Restoration after Two Centuries of Multiple-Use Management in Algonquin Park, Ontario, Canada

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Abstract

Globally, timber production continues to dominate multiple-use forest management despite evidence from many managed landscapes that ecological integrity and biodiversity are not being sustained under that land-use model. This includes Algonquin Park where two centuries of road building, logging, and aggregate mining have contributed to a ~82% (6,200 km²) reduction of unlogged, roadless (>1km from roads) habitat at a mean decline rate of 32 km²/yr. There are at least ~5,500 km of roads that fragment Algonquin Park into 732 roadless habitats covering 18% of the Park's area. Almost 40,000 ha of these habitats are unprotected from logging. Decline of roadless habitat in Algonquin has contributed to the impairment of ecological integrity and decline of at least 33 species across all trophic levels, including at least 17 species-at-risk. Restoring the natural Algonquin Park landscape would result in job losses, however, data suggest that new recreation-tourism and research-education jobs would help to offset these losses. A new agency could build on existing infrastructure to monitor, research, educate about, maintain, and restore biodiversity and recreational resources in the greater Algonquin Park Region, with the park as the central hub. Restoration could be focused on roadless areas as an "integrative" indicator of ecological integrity.

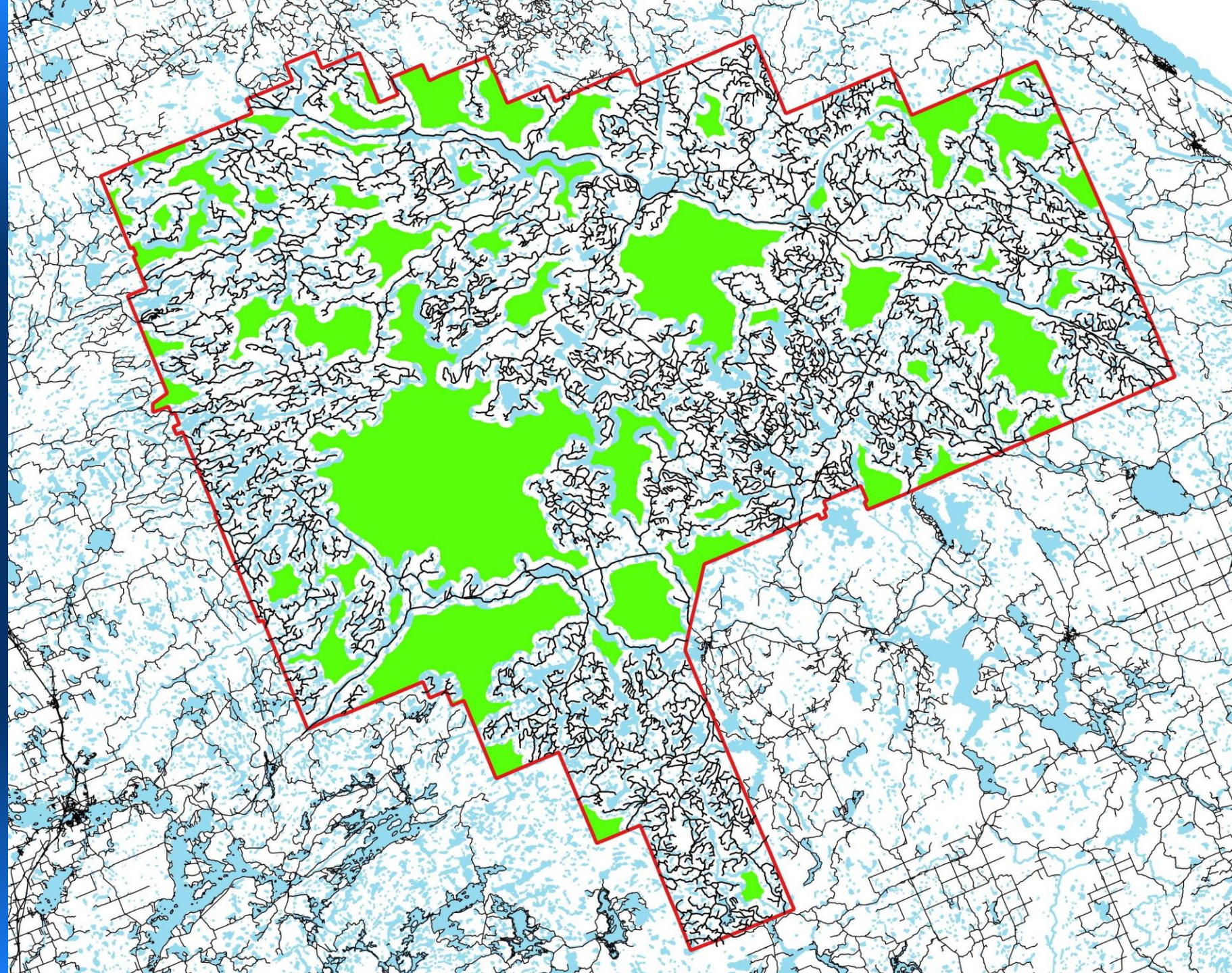
Keywords: ecological integrity indicators; biodiversity; Algonquin Park; logging; mining; roads and roadless areas; restoration

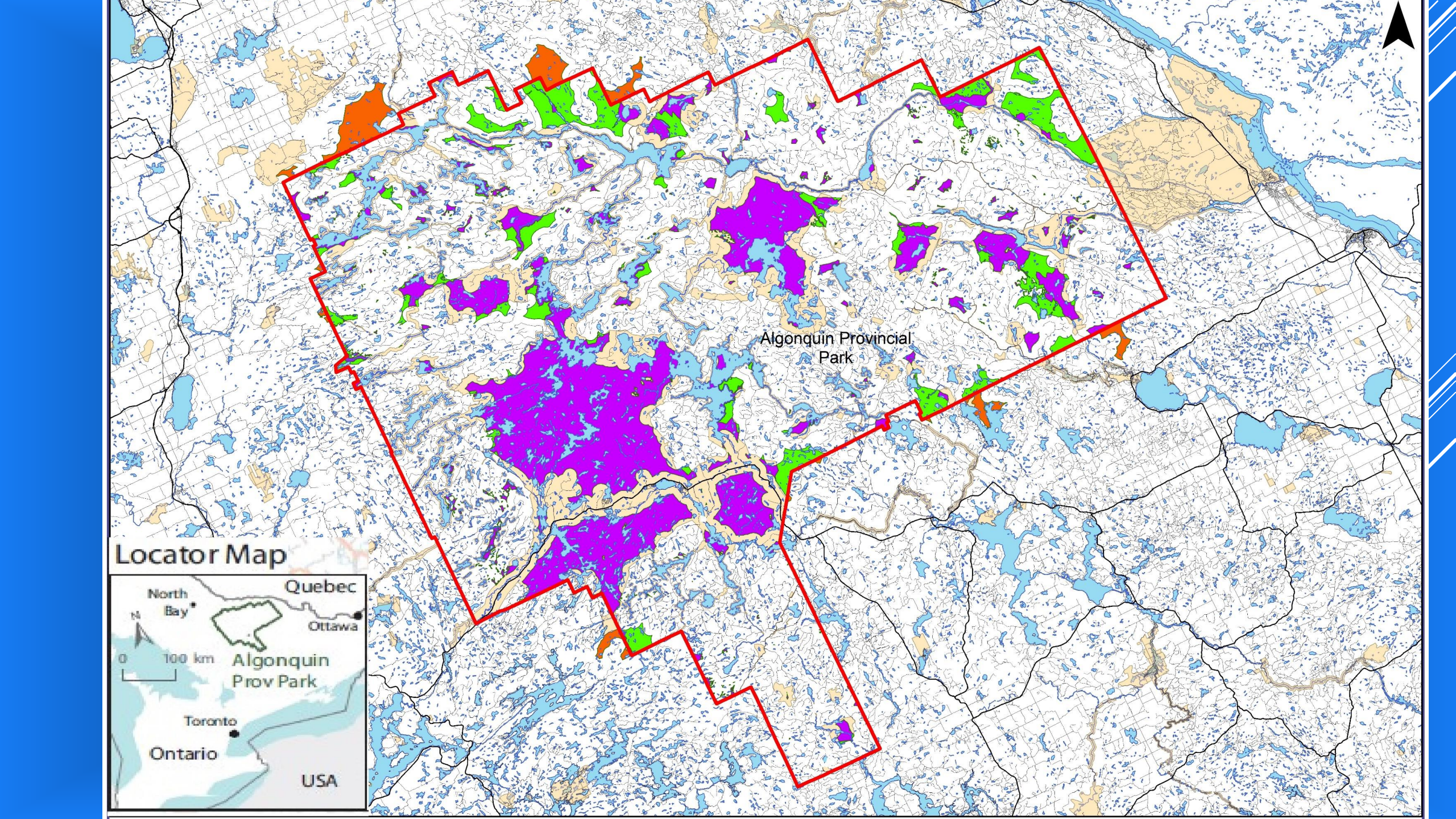
Table 2. Decline of Species and Ecological Integrity in Algonquin Park, Ontario.

Species and Ecological Integrity Metrics	Quantity/ Change	References
Species Declines		
Mammals	3	beaver (Quinn, 2005), moose (McLaughlin et al., 2011), eastern wolf (Benson et al., 2015)
Birds	12	barred owl (AES, 2010), blackburnian warbler (AES, 2010), black-throated blue warbler (Jobes et al., 2004), brown creeper (Geleynse et al., 2015), gray jay (OMECP, 2025), oven bird (Jobes et al., 2004), parula warbler (AES, 2010), red-shouldered hawk (Naylor et al., 2004), saw-whet owl (AES, 2010), white-winged crossbill (AES, 2010), wood thrush (AES, 2010) and yellow-bellied sapsucker (Jobes et al., 2004)
Fish	1	brook trout (Banks, 2009)
Crustaceans	1	crayfish (Towers, 2015)
Insects	3	bees (Nol et al., 2006, Nardone, 2013), click beetles (Nol et al., 2006), and hoverflies (Nol et al., 2006)
Trees	13	American elm (Leadbitter, 2002), basswood (Leadbitter, 2002), black cherry (Leadbitter, 2002), eastern hemlock (AES, 2009), eastern white pine (Quinn, 2004, Thompson et al., 2006), jack pine (Cumming & Janke, 2010), larch/tamarack (Pinto et al., 2006), northern white cedar

Decline in Ecological Integrity Indicators		
Roadless wildlife habitat	-82%	this study
White pine density	-88%	Thompson et al. (2006)
White pine tree diameter	-61%	Thompson et al. (2006)
White pine stand abundance	-40%	Thompson et al. (2006)
Super-canopy trees	decrease	Quinn (2004)
Large snags	decrease	Quinn (2004)
Large logs	decrease	Quinn (2004)
Carbon storage/forest biomass	decrease	Quinn (2004)
Riparian habitat	decrease	Quinn (2004)
Conifer forest	decrease	Quinn (2004)
Canopy cover	decrease	Quinn (2004)
Site productivity	decrease	Quinn (2004)
Species-at-risk (residents only)	+17	Cumming and Janke (2010)
Non-native, alien species	+200	Mead et al. (2000)

Roads and Roadless Wildlife Habitat Algonquin Park




Algonquin Provincial Park
Locator Map
Quebec
North Bay
Ottawa
N
0
100 km
Algonquin Prov Park
Toronto
Ontario
USA

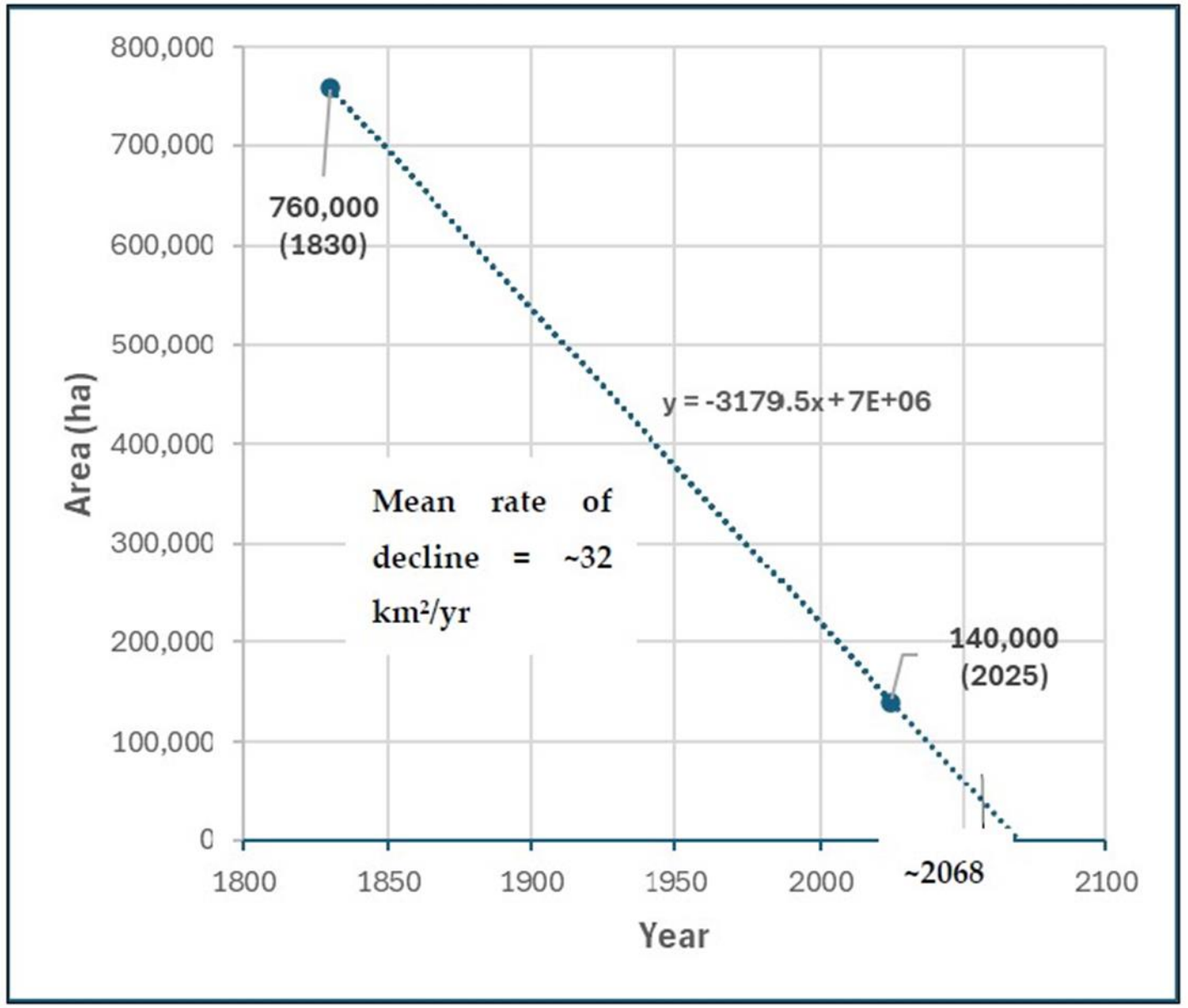


Figure 3. Rate of Decline of Roadless Wildlife Habitat in Algonquin Park, Ontario from 1830 to 2025.