Fire in northern Minnesota forests: the Cavity Lake and Ham Lake Wildfires in historical and future perspectives

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Vice Chair—Great River Greening

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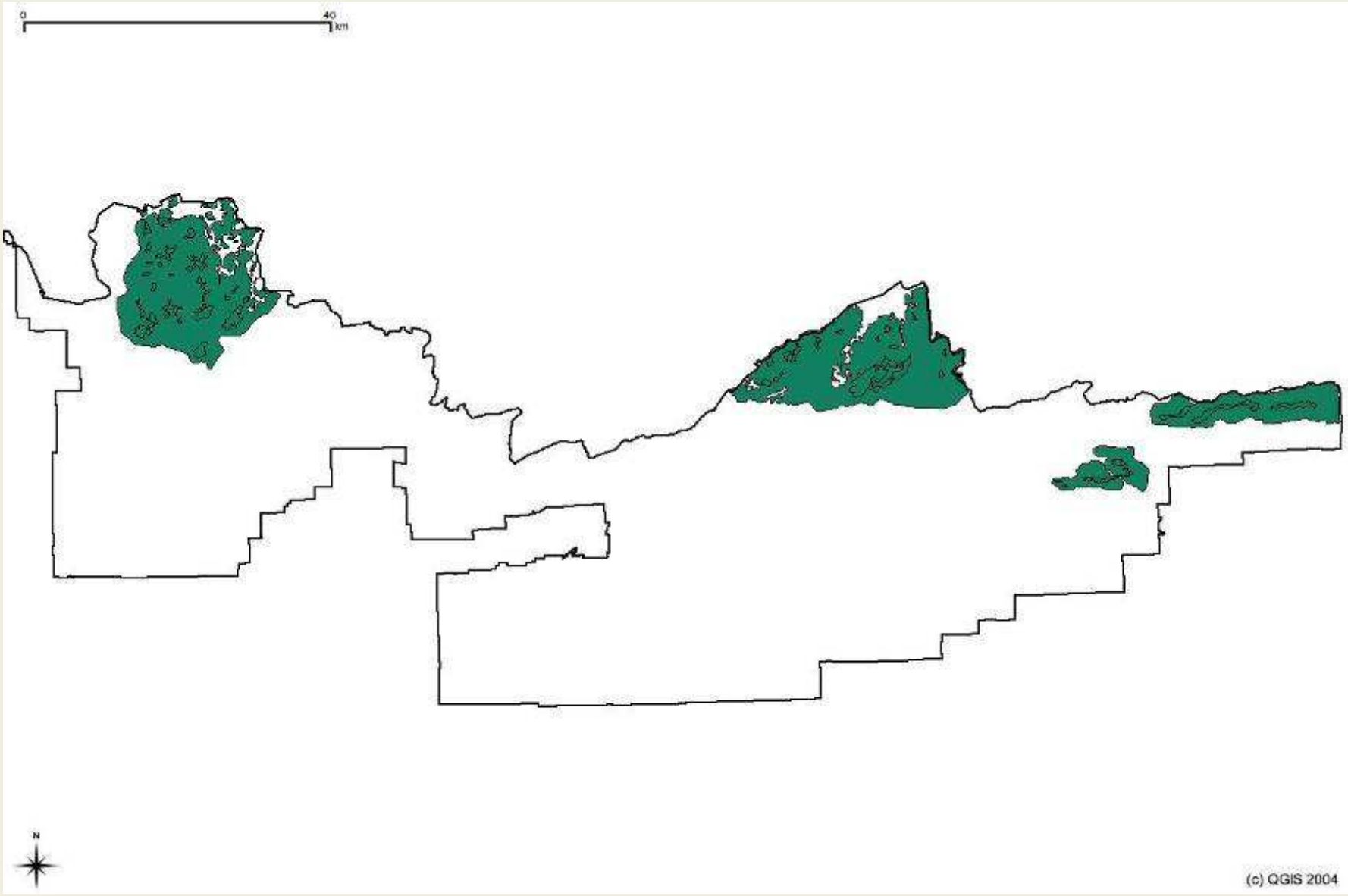
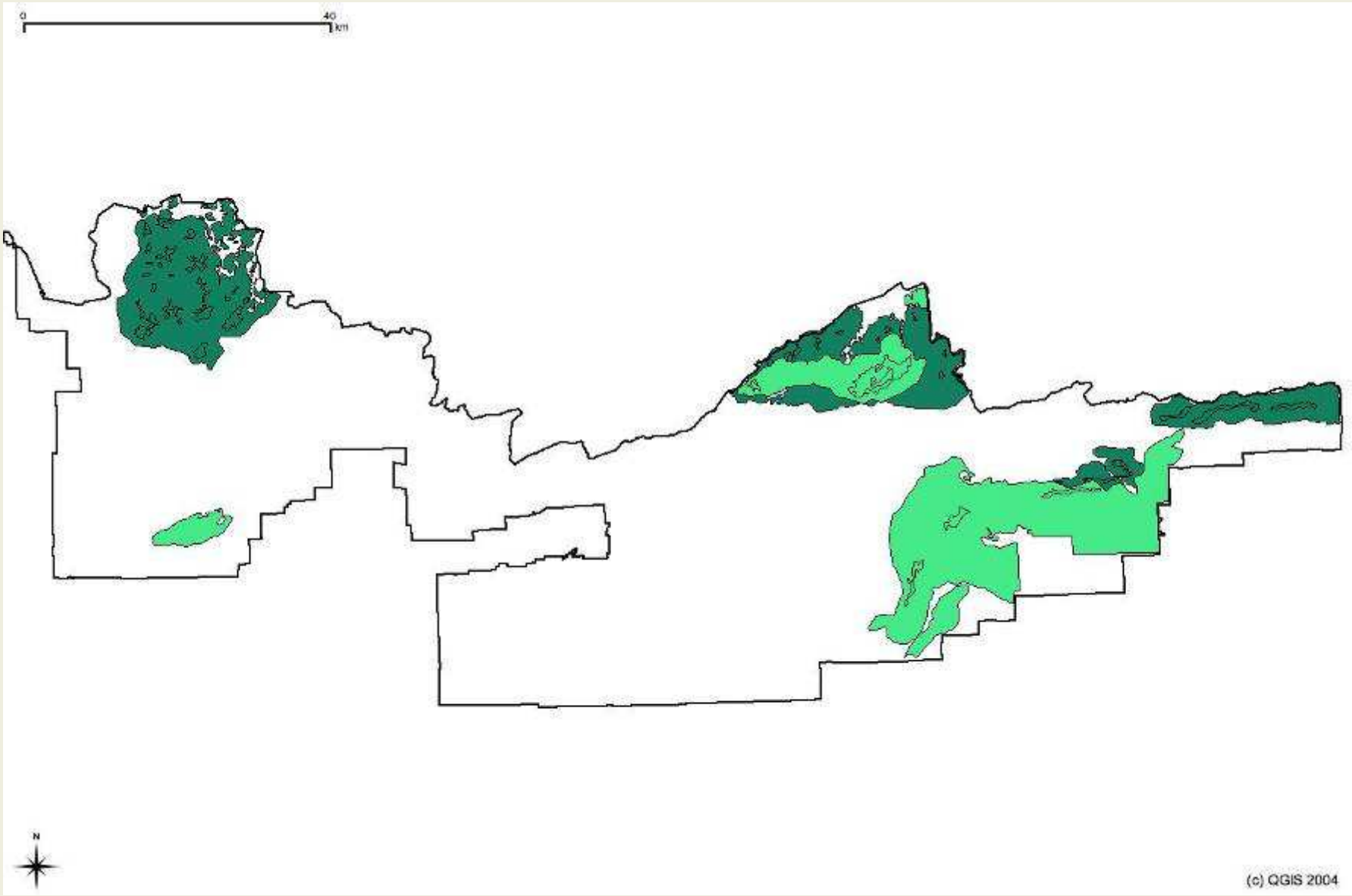
Heinselman used fire scars and tree ages to date fires since 1595

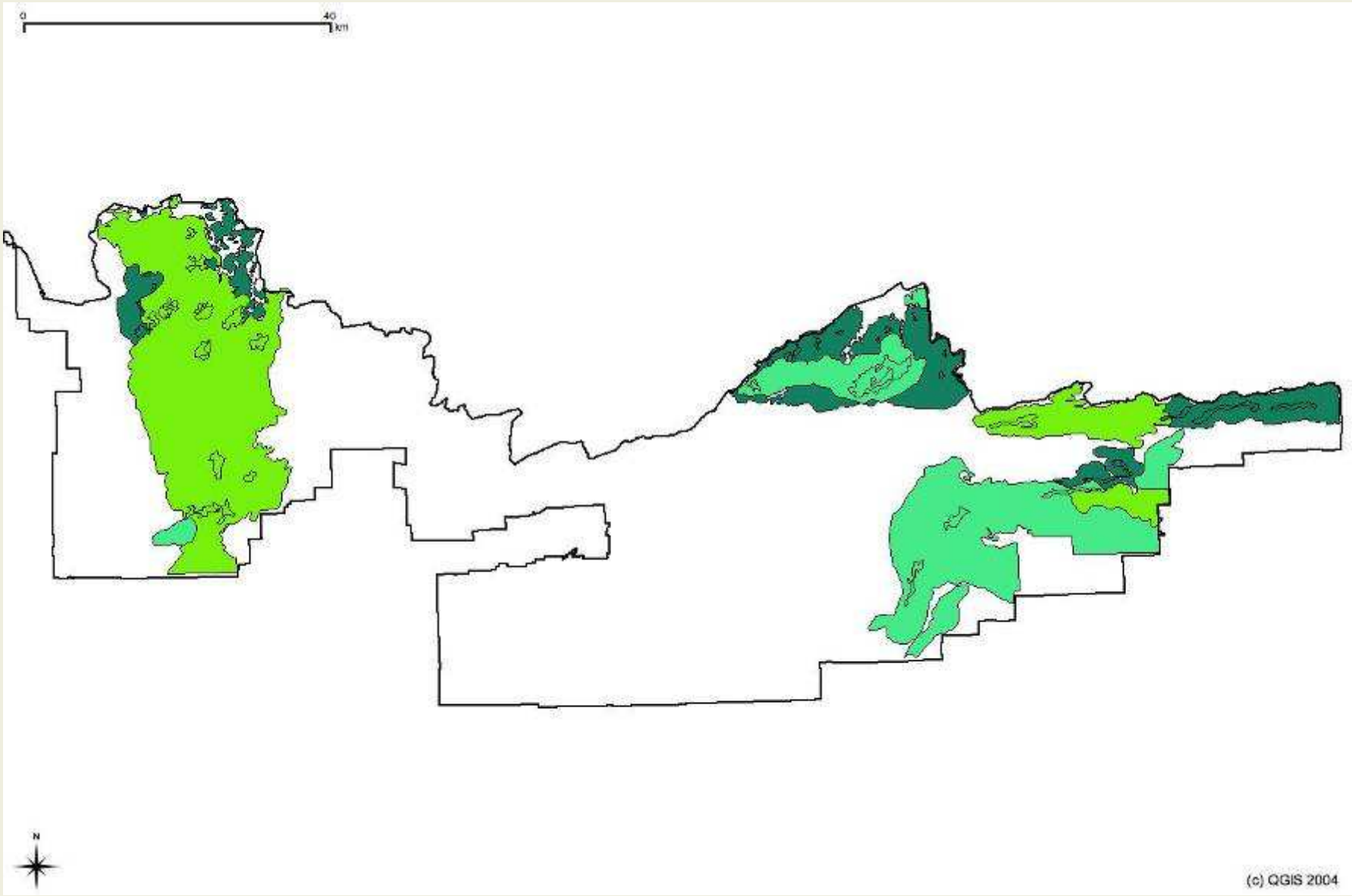
Photos: Bud Heinselman



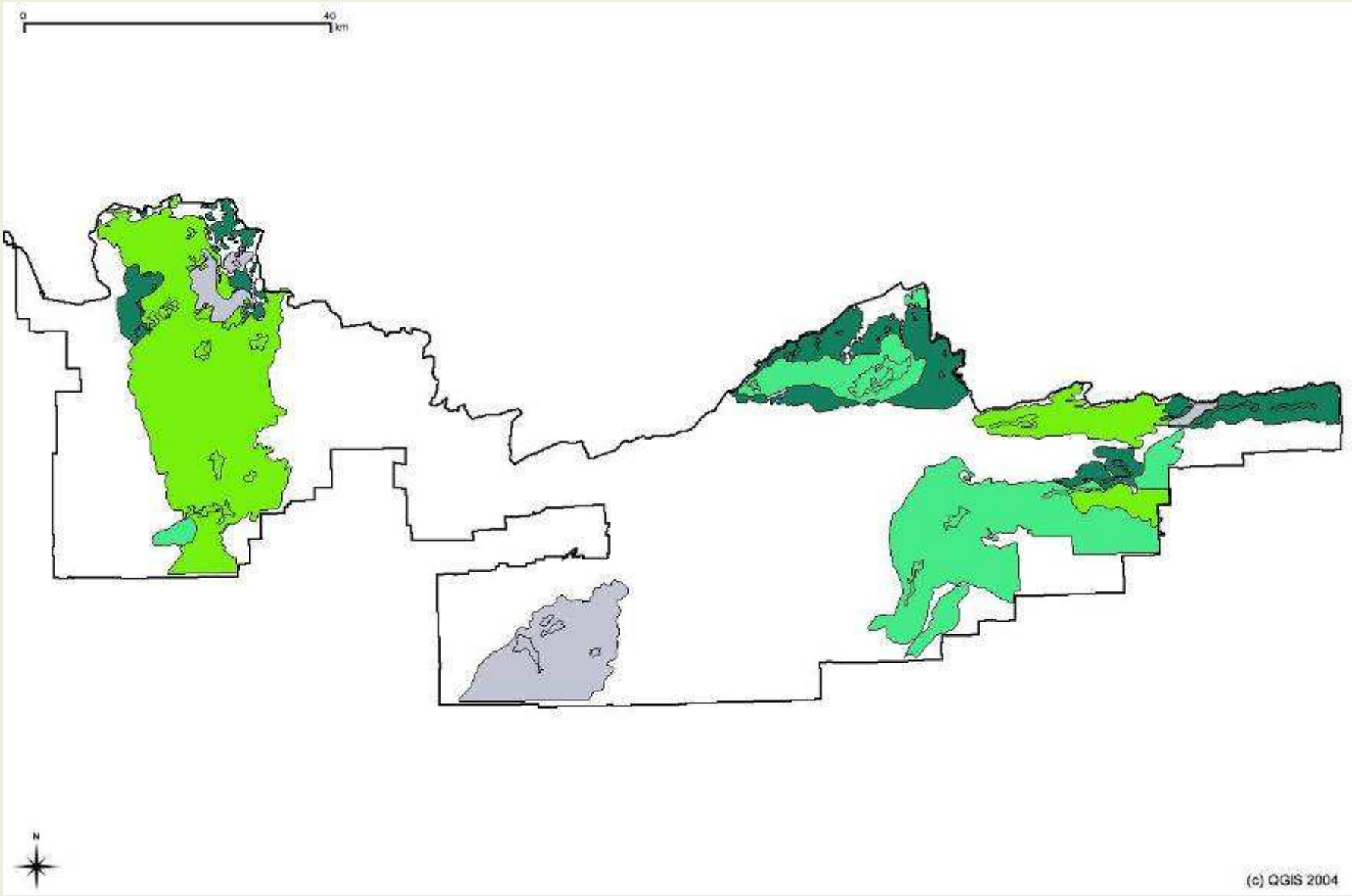
Heinselman BWCAW area burn maps 1610 – 1692.



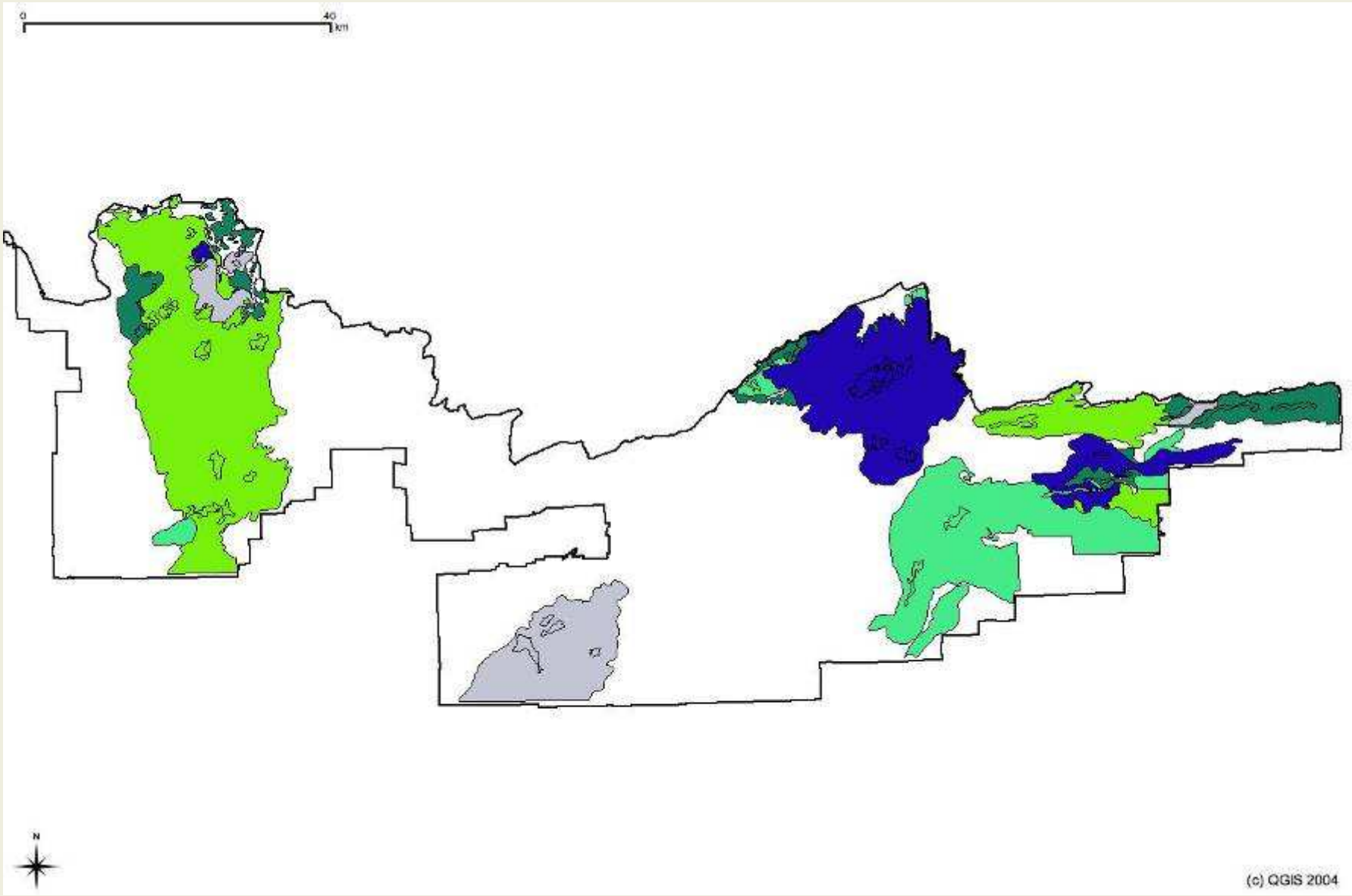
Heinselman BWCAW area burn maps 1712 – 1747.



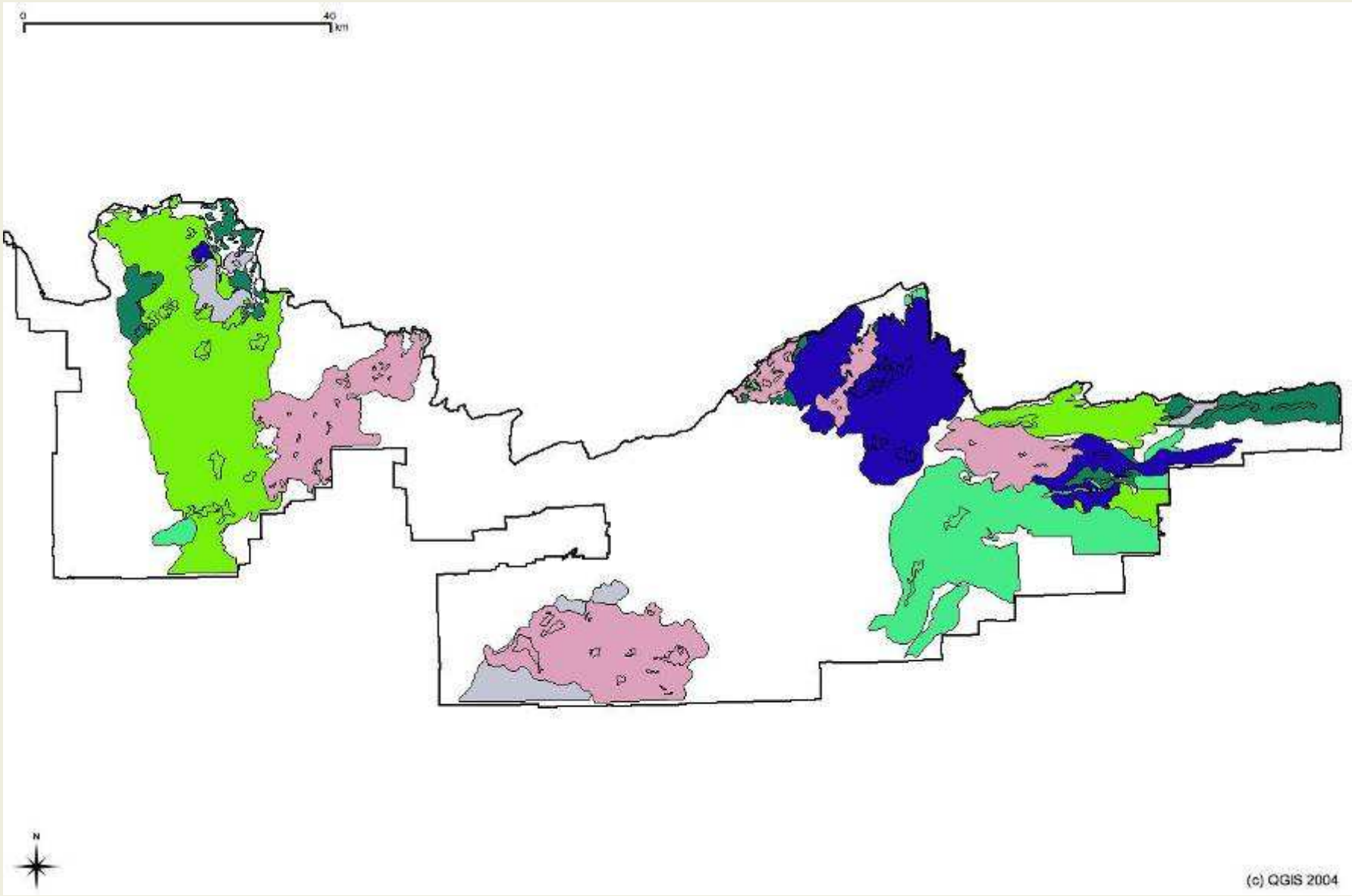
Heinselman BWCAW area burn maps 1755 – 1759.



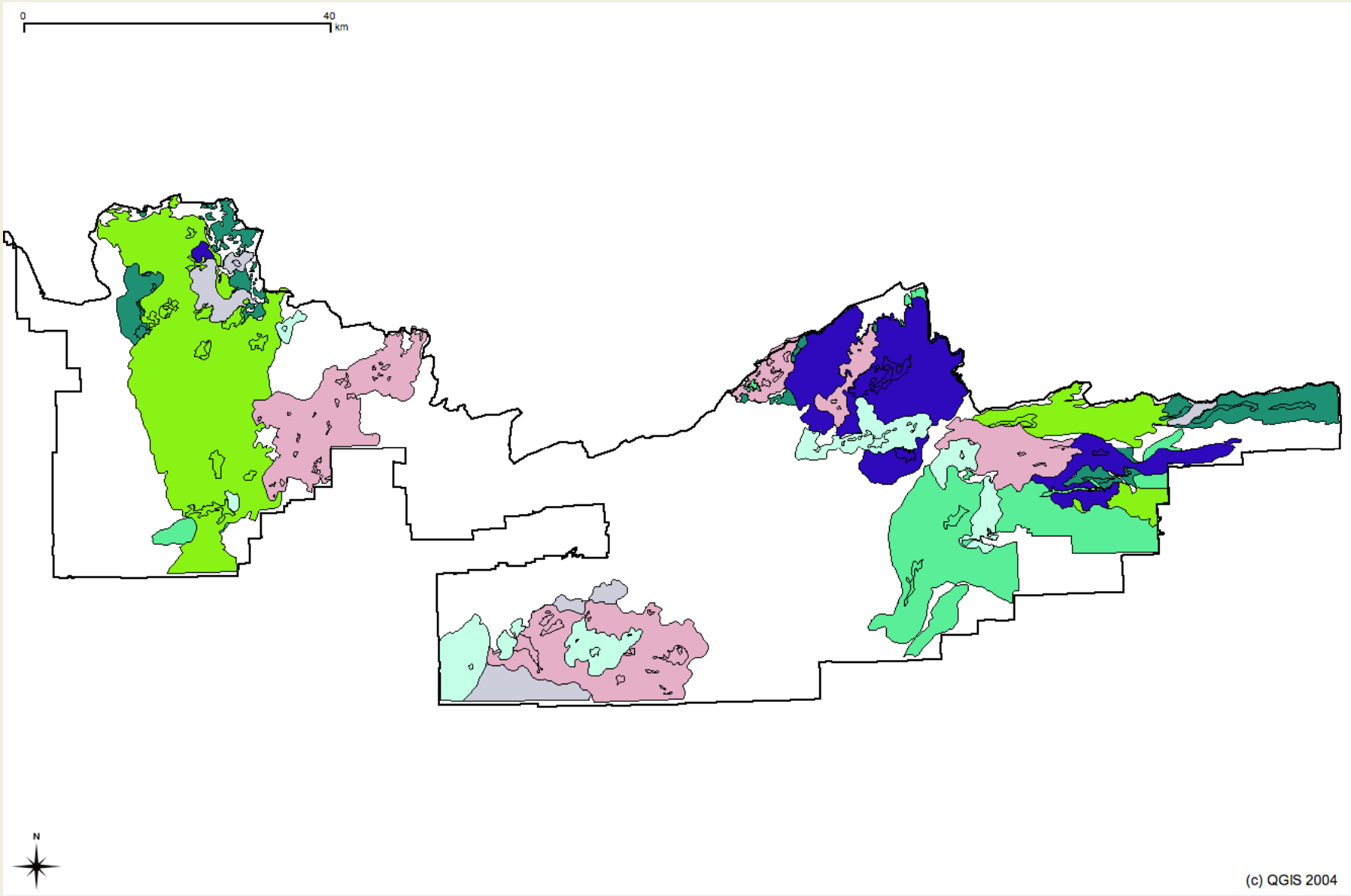
Heinselman BWCAW area burn maps 1784 – 1796.



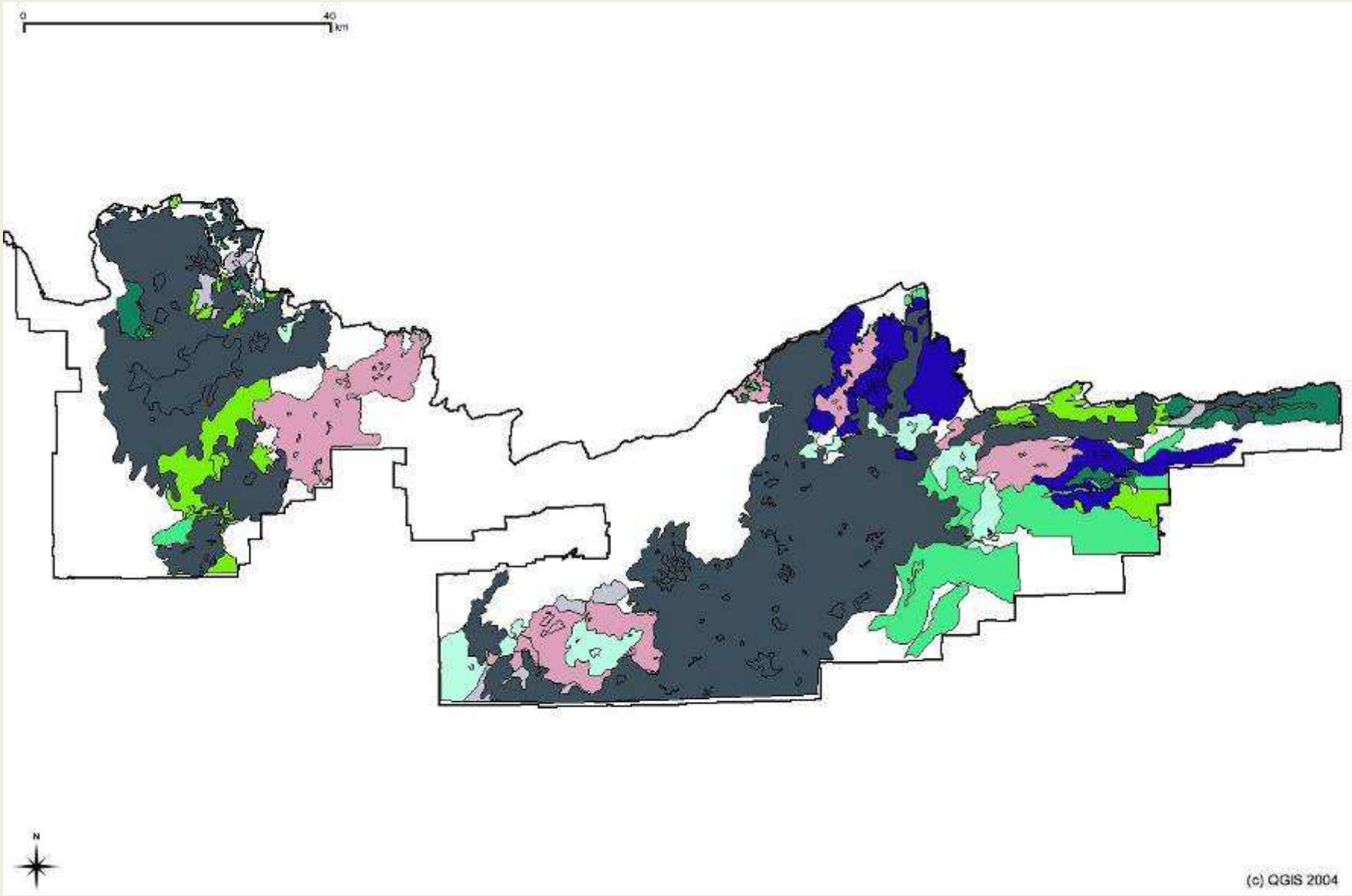
Heinselman BWCAW area burn maps 1801 – 1803.



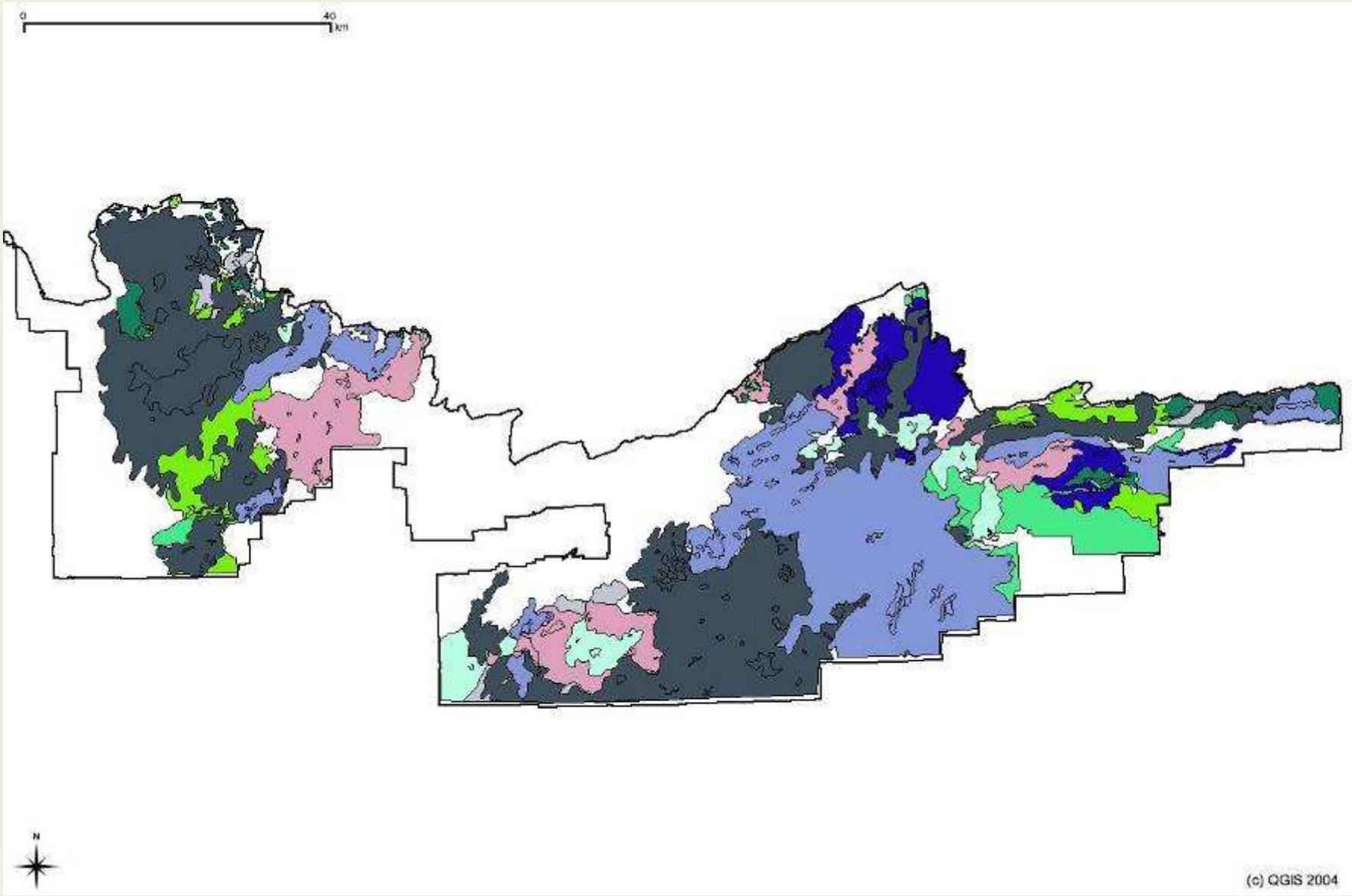
Heinselman BWCAW area burn maps 1815 – 1827.



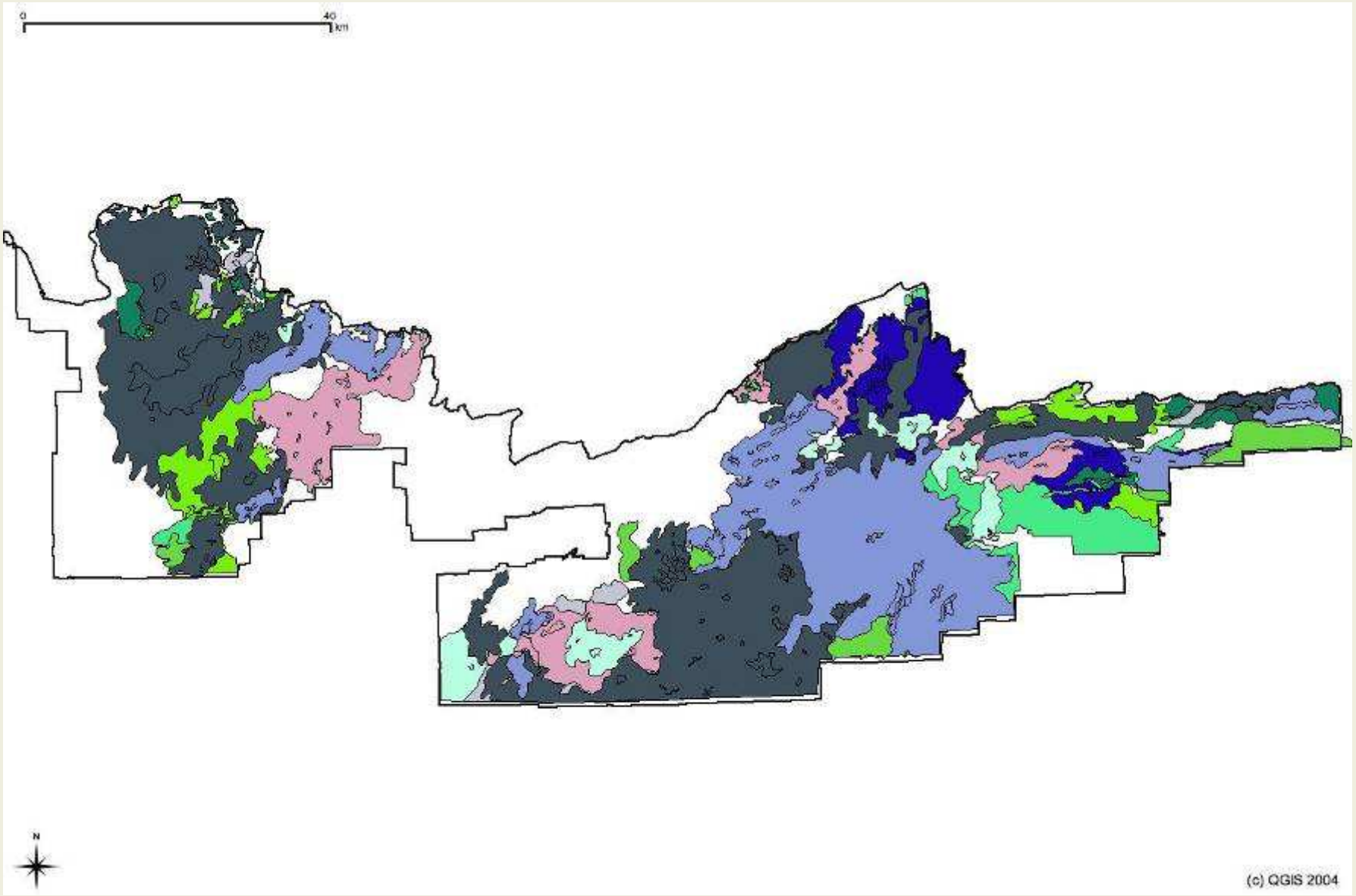
Heinselman BWCAW area burn maps 1834 – 1854.



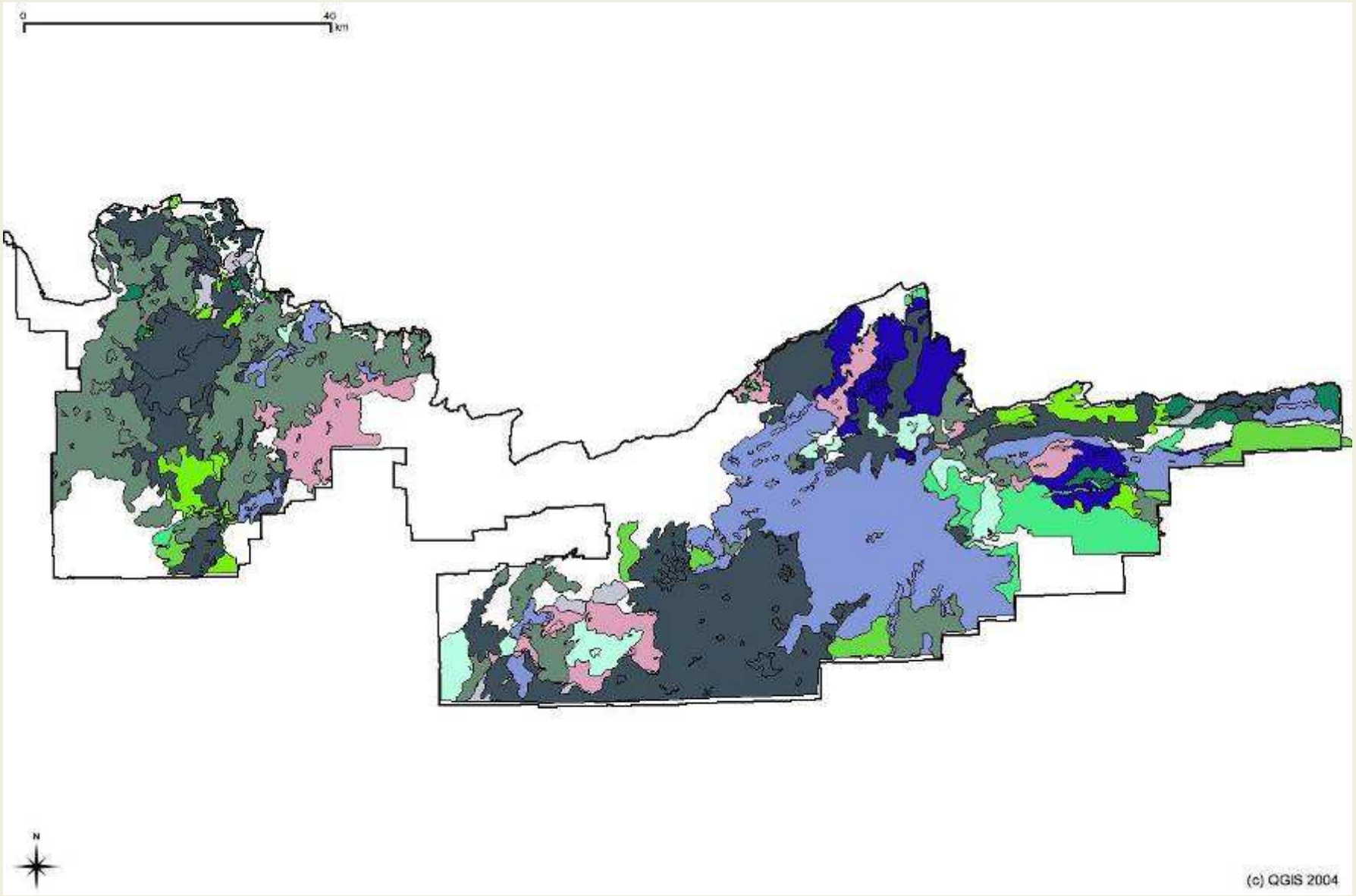
Heinselman BWCAW area burn maps 1863 – 1864.



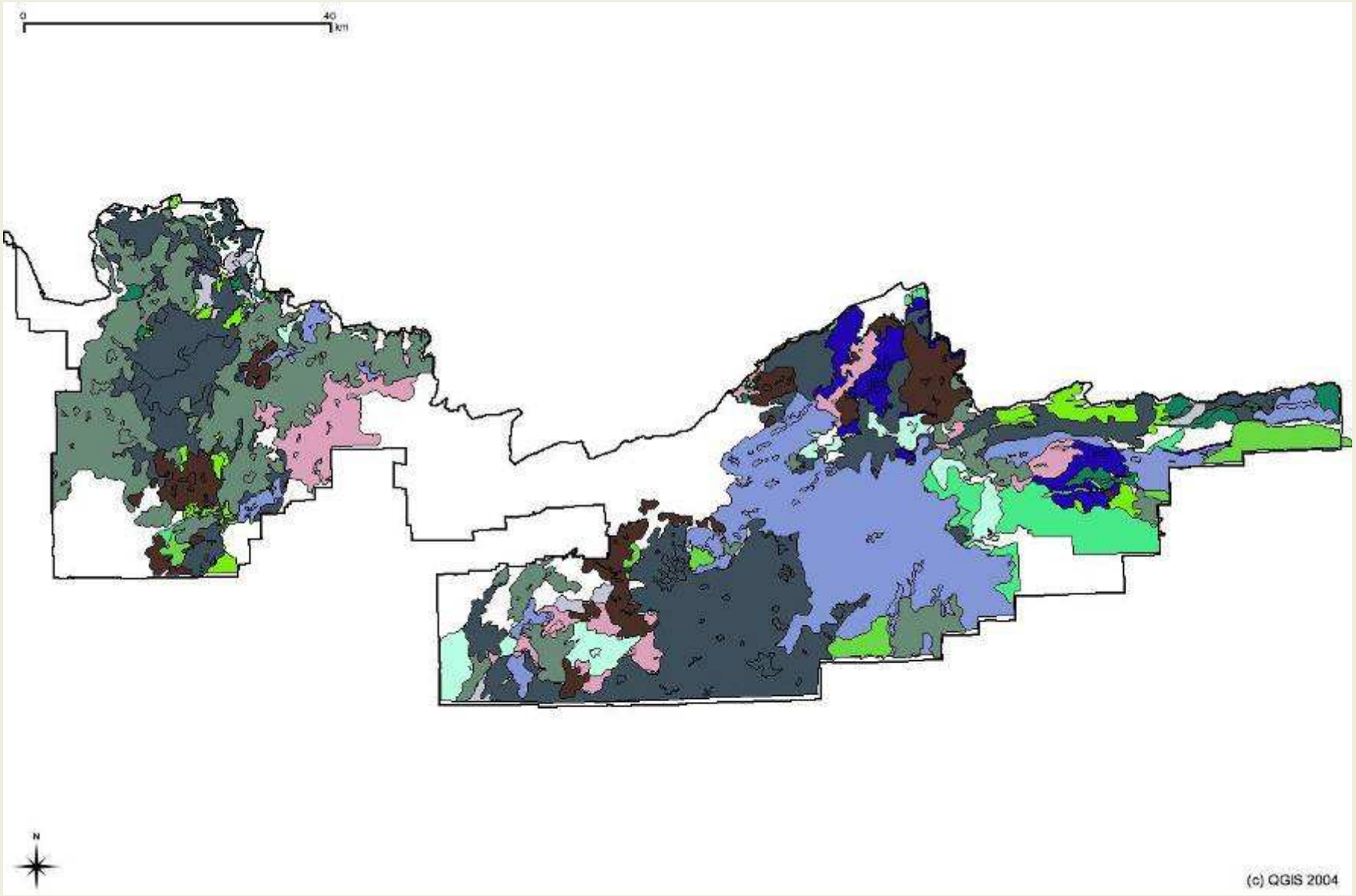
Heinselman BWCAW area burn maps 1871 – 1875.



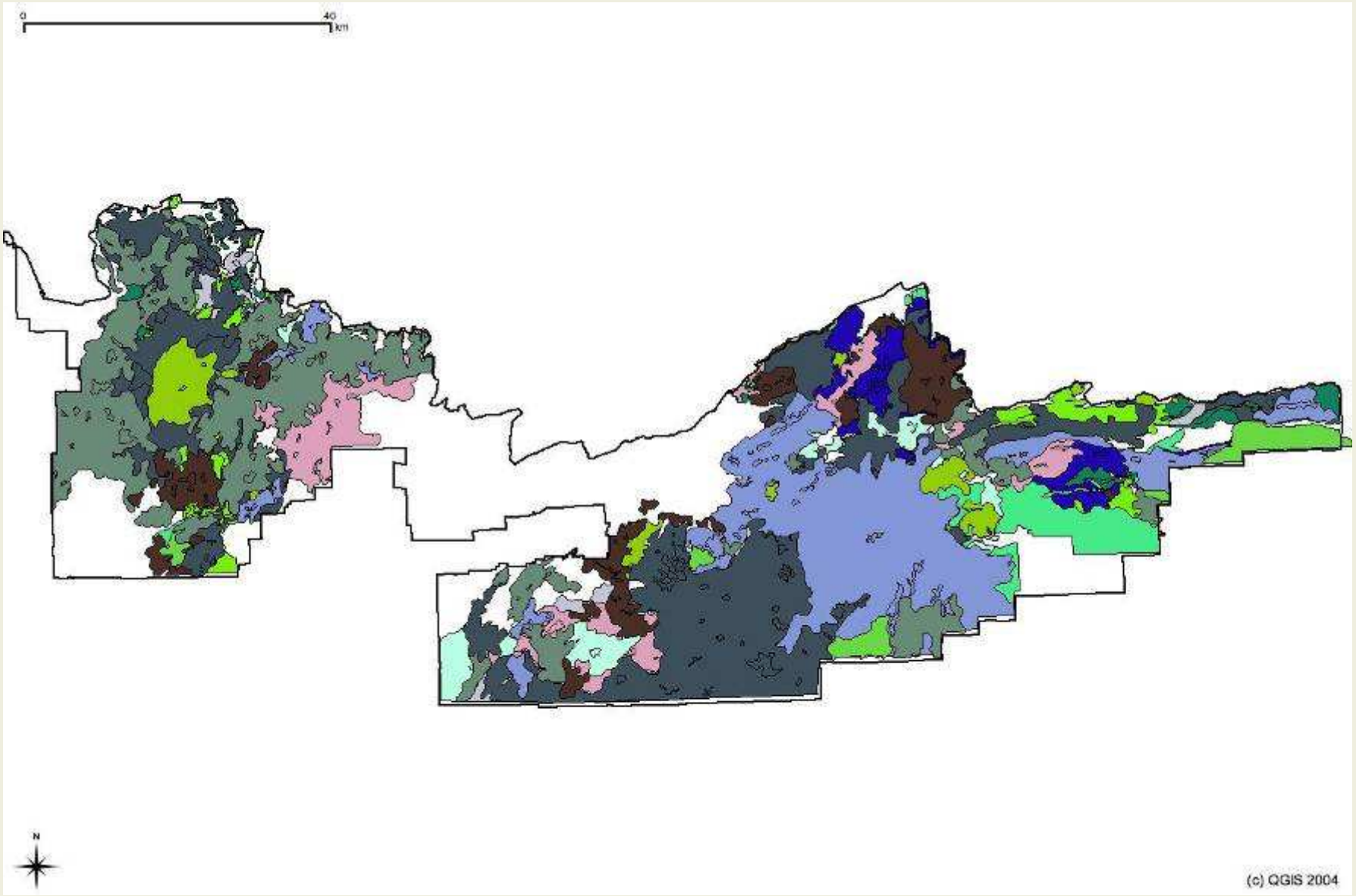
Heinselman BWCAW area burn maps 1880 – 1890.



Heinselman BWCAW area burn maps 1894.



Heinselman BWCAW area burn maps 1900 – 1920.



Heinselman BWCAW area burn maps 1921-1971.

High intensity crown fire in jack pine

Photos: Bud Heinselman

Serotinous cones of jack pine before scorching (lower) and after fire (upper)

Photos: Bud Heinselman

Jack pine regeneration a few months and 3 years after fire

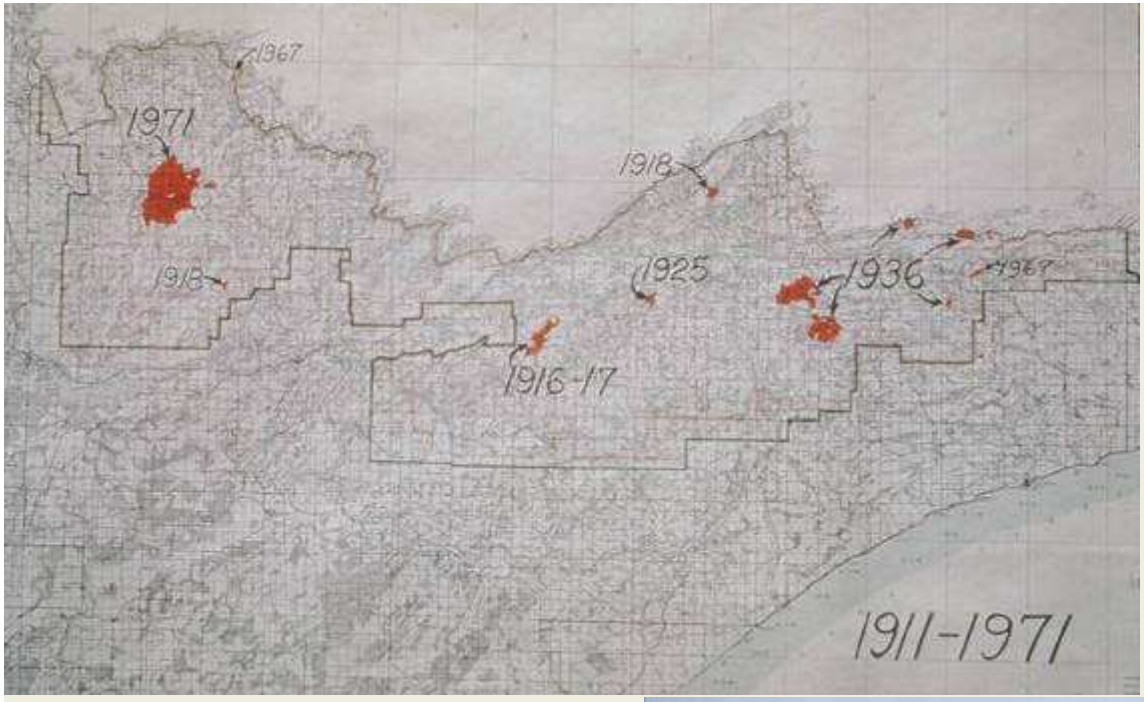
Photos: Bud Heinselman

Stem exclusion phase at ages 17 and 50

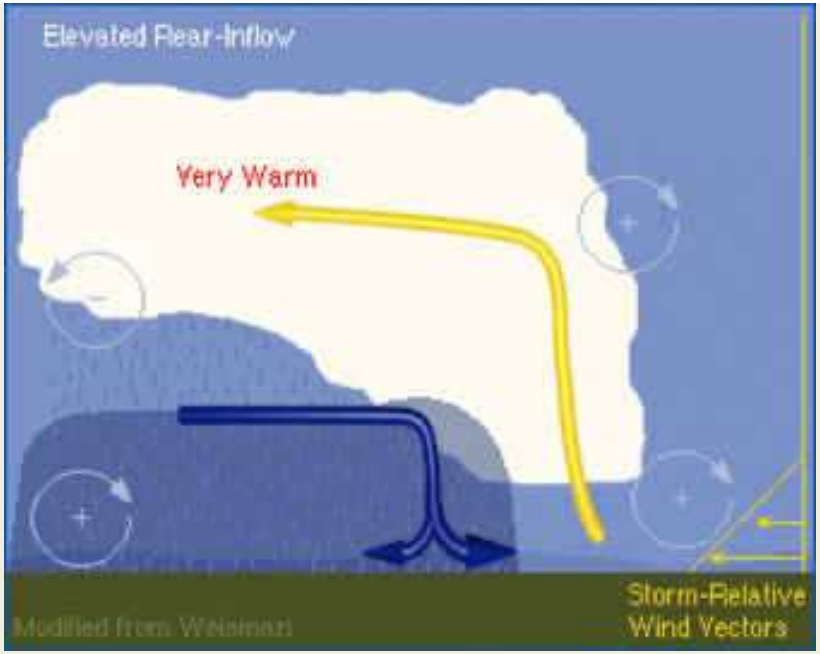
White and red pine in the boreal forest occupy areas with less than average fire intensity—peninsulas, islands and lakeshores

Photos: Bud Heinselman

Red and white pine burning and recovery after nine years



190-year-old jack pine
as a result of fire exclusion
during the 20th Century

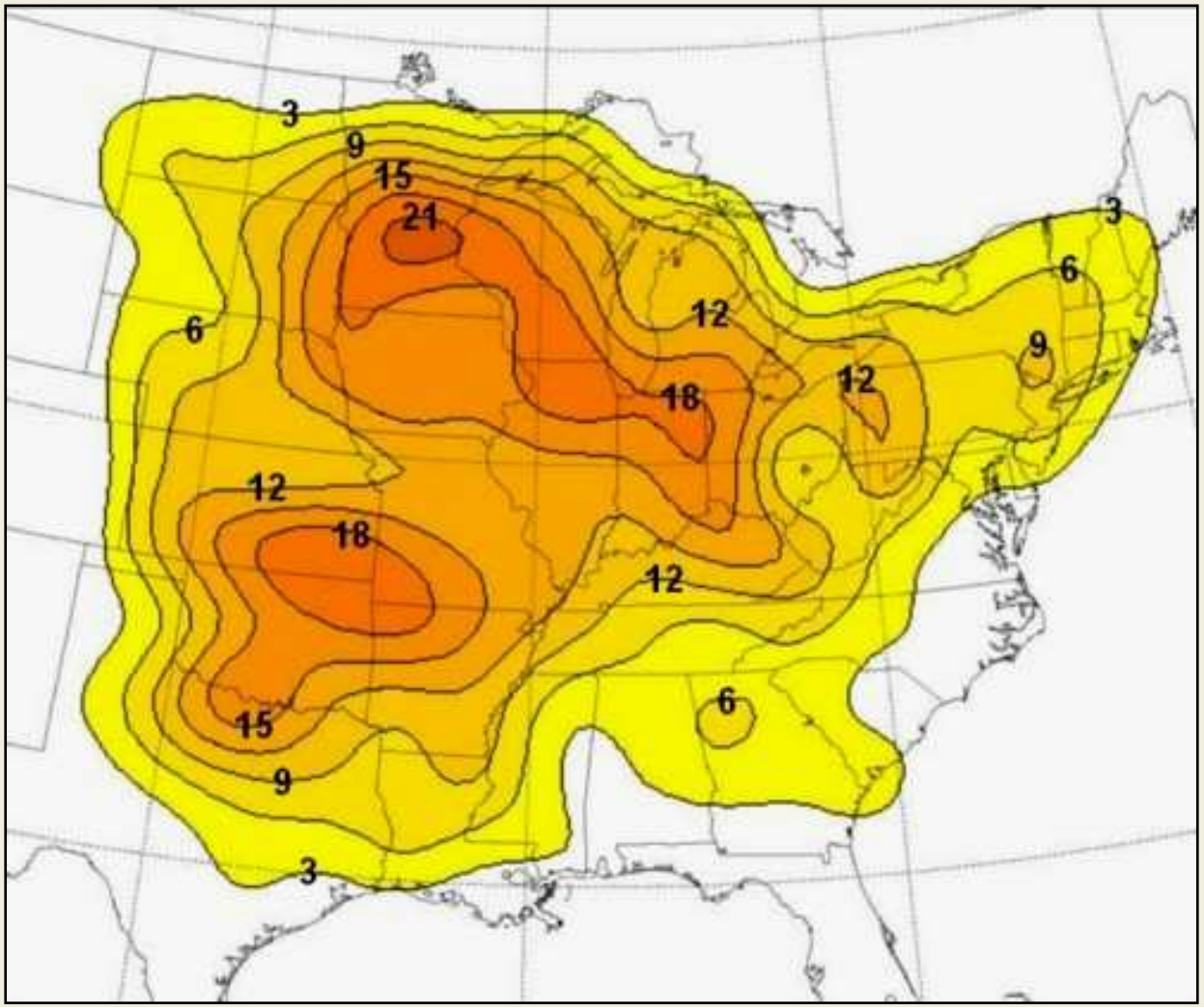


From COMET, 1999, modified from Weisman, 1993.

Derecho downburst development

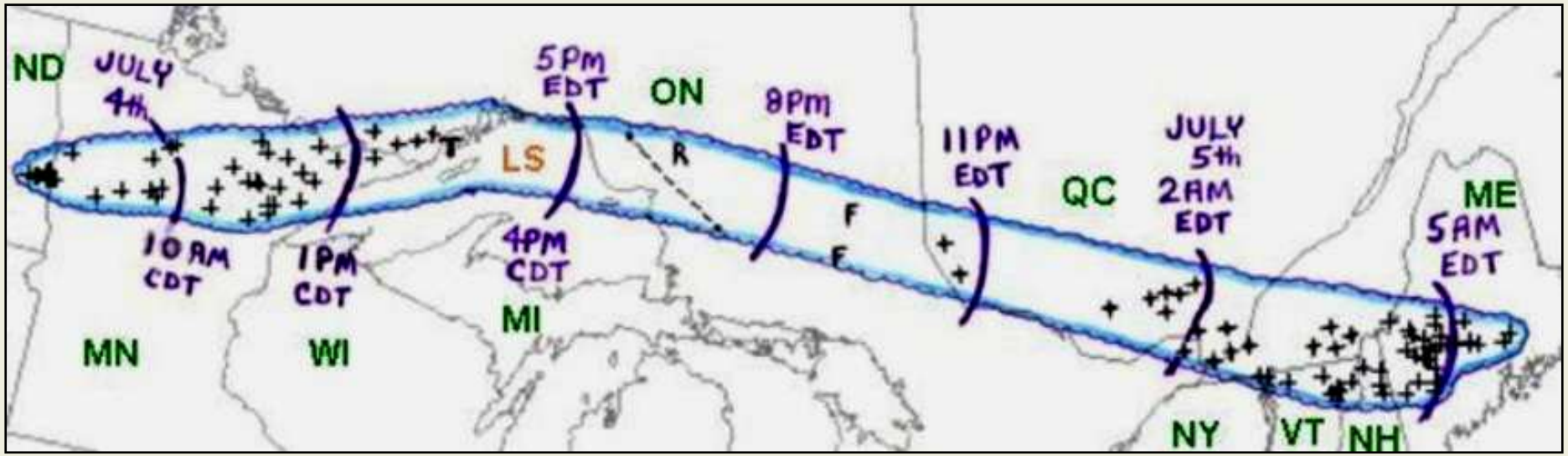
From: R.H. Johns and J.S. Evans: www.spc.noaa.gov/misc/AbtDerechos

Wind as a disturbance in forests:
Number of derechos observed in 22 years



From: R.H. Johns and J.S. Evans: www.spc.noaa.gov/misc/AbtDerechos

The BWCAW derecho, July 4, 1999: a combination bow echo and supercell derecho that crossed half of North America



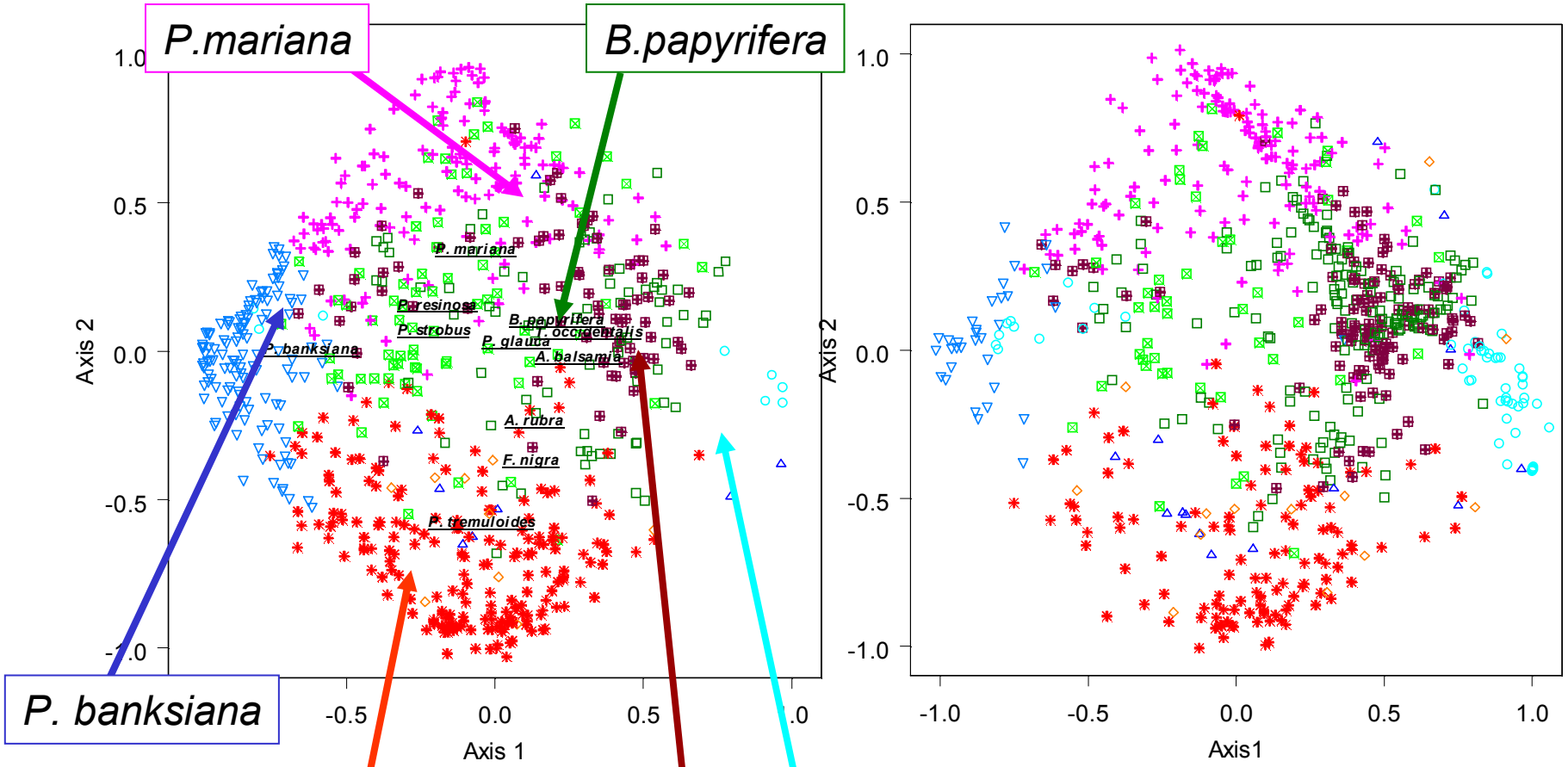
From: R.H. Johns and J.S. Evans: www.spc.noaa.gov/misc/AbtDerechos

Minneapolis Star Tribune

Before and after the 1999 blowdown

Photos: Dave Hansen

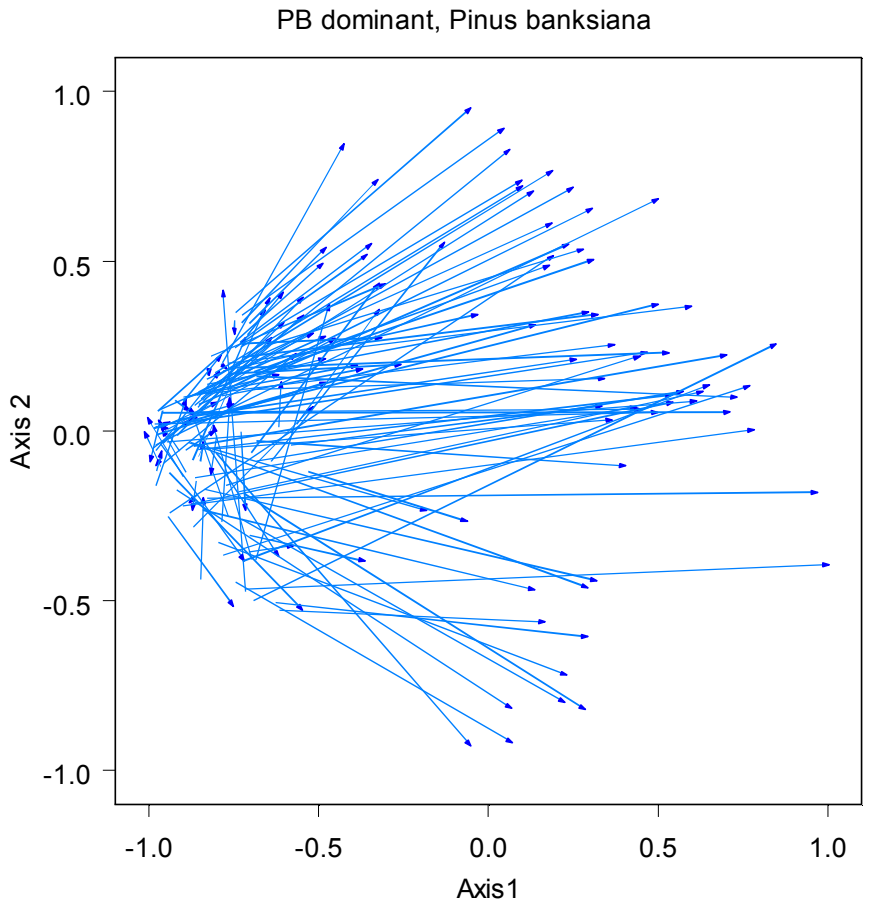
Composition NMS derived from relative basal area

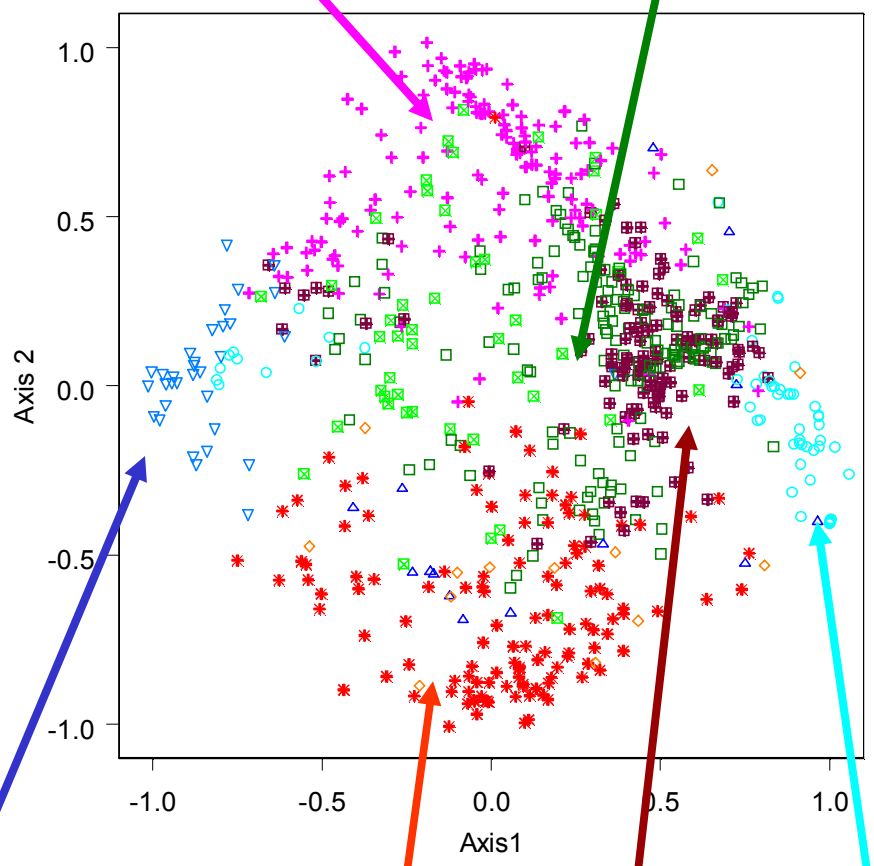


Axis	Increment R^2	Cumulative R^2
1	0.172	0.172
2	0.175	0.346
3	0.253	0.600

Final Stress ~ 22

Jack pine forest transitions





P.mariana

B.papyrifera

P. banksiana

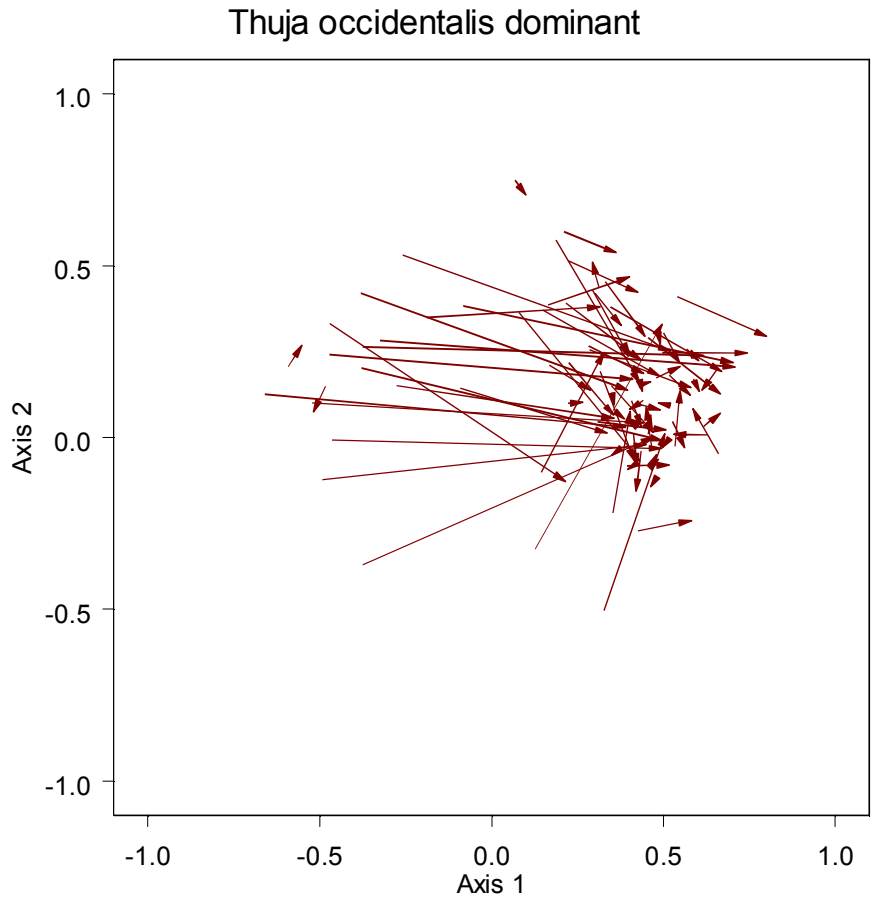
P. tremuloides

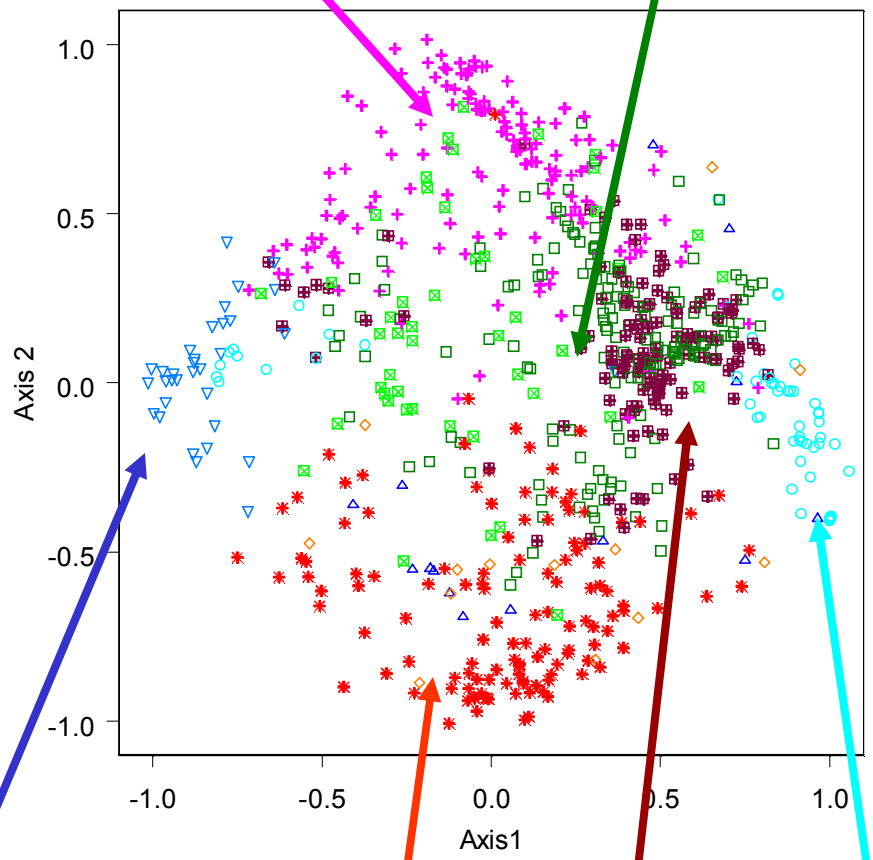
T.occidentalis

A. balsamea

- AB dominant
- AR AB
- BP AB
- FN dominant
- PB dominant
- PM dominant
- PR and PS codominant
- PT dominant
- TO dominant

White cedar transitions





P.mariana

B.papyrifera

P. banksiana

P. tremuloides

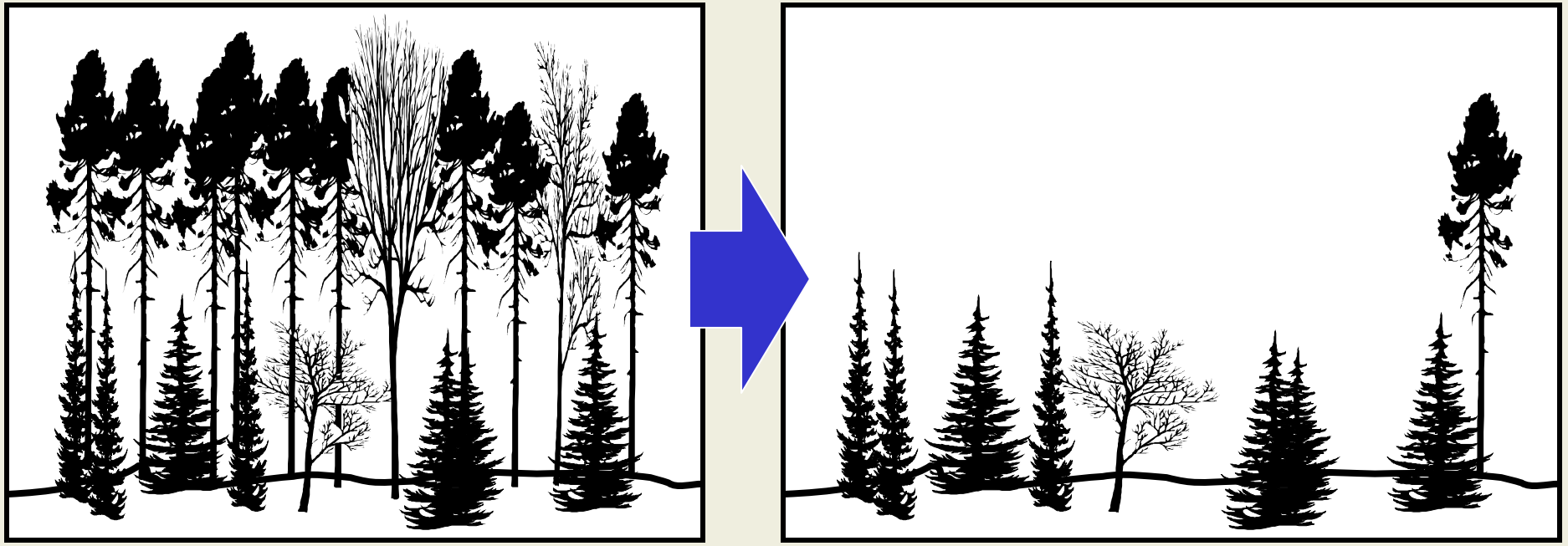
T.occidentalis

A. balsamea

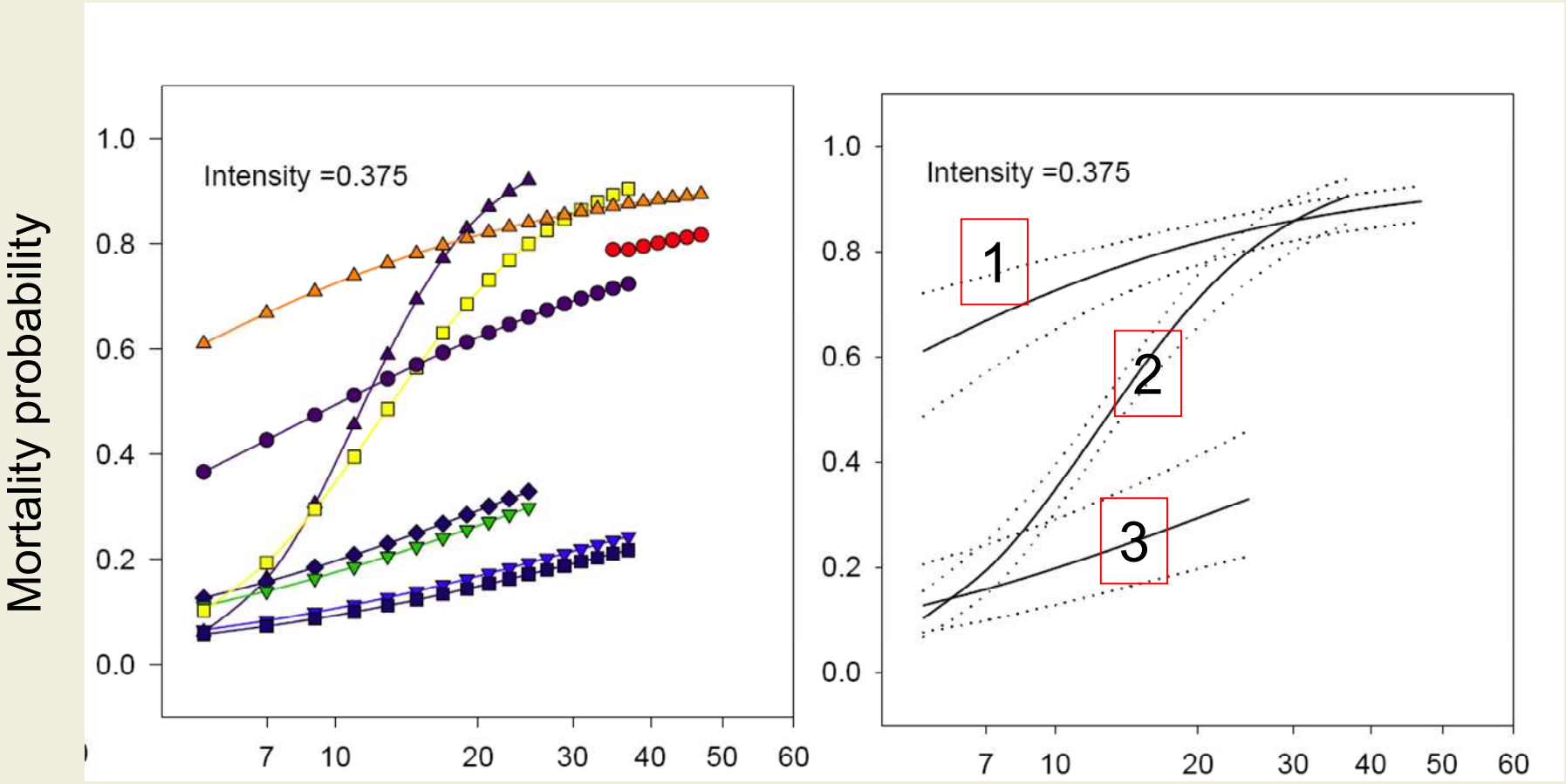
- AB dominant
- AR AB
- BP AB
- FN dominant
- PB dominant
- PM dominant
- PR and PS codominant
- PT dominant
- TO dominant

Community transition matrix

		Post-storm Community Groups							Summary	
		Jack Pine	Aspen	Mixed Conifer	Birch-Fir	Balsam Fir	Black Spruce	Cedar	#plots pre-storm	%total pre-storm
Pre-storm Community	Jack Pine	23.7	8.4	26.72	15.27	3.82	15.27	6.87	131	17.7
	Aspen	2.27	45.91	11.82	15.91	11.36	6.36	6.36	220	29.8
	Conifer	0.6	0.6	52.1	9.58	9.58	14.97	12.57	167	22.6
	Birch-Fir	0	1.89	5.66	84.91	7.55	0	0	53	7.2
	Balsam Fir	0	20	0	0	80	0	0	10	1.4
	Spruce	0	1	6	19	1	72	1	100	13.5
	Cedar	0	0	0	0	0	1	96.55	58	7.8
#plots post-storm		37	117	159	135	59	131	101	739	
%total post storm		5	15.8	21.5	18.3	8	17.7	13.7		



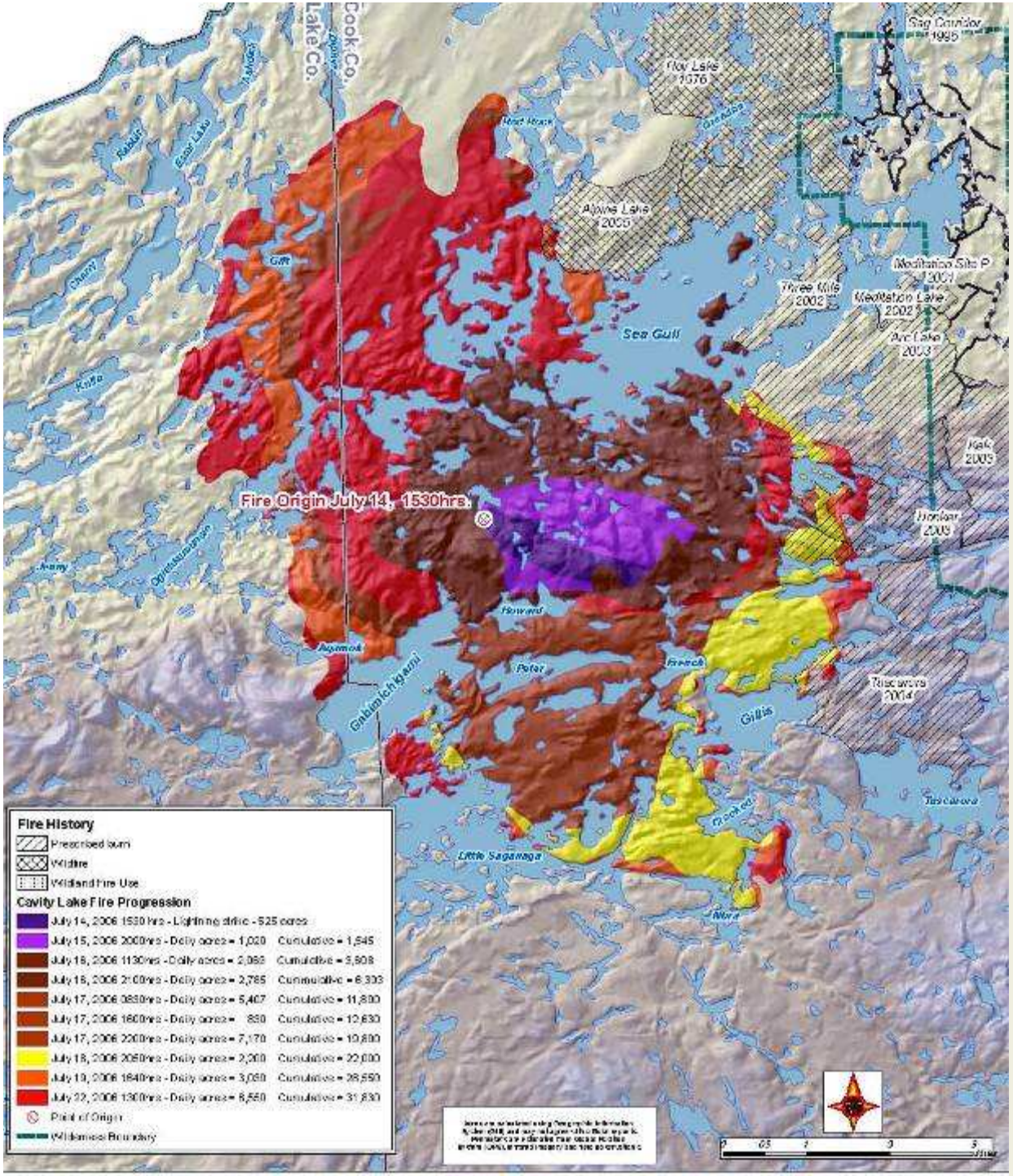
Wind does selective weeding of the forest



1. Early successional species
2. Spire-formed conifers
3. Late-successional species

After Rich, Frelich and Reich, 2007, *Journal of Ecology* 95: 1261-1273

200 year old red pine forest after big blowdown



Progression map for
Cavity Lake Fire—July 2006

Photos: Alex Reich

Start of Cavity Lake Fire
and escape by University of MN
Post-Doc Roy Rich

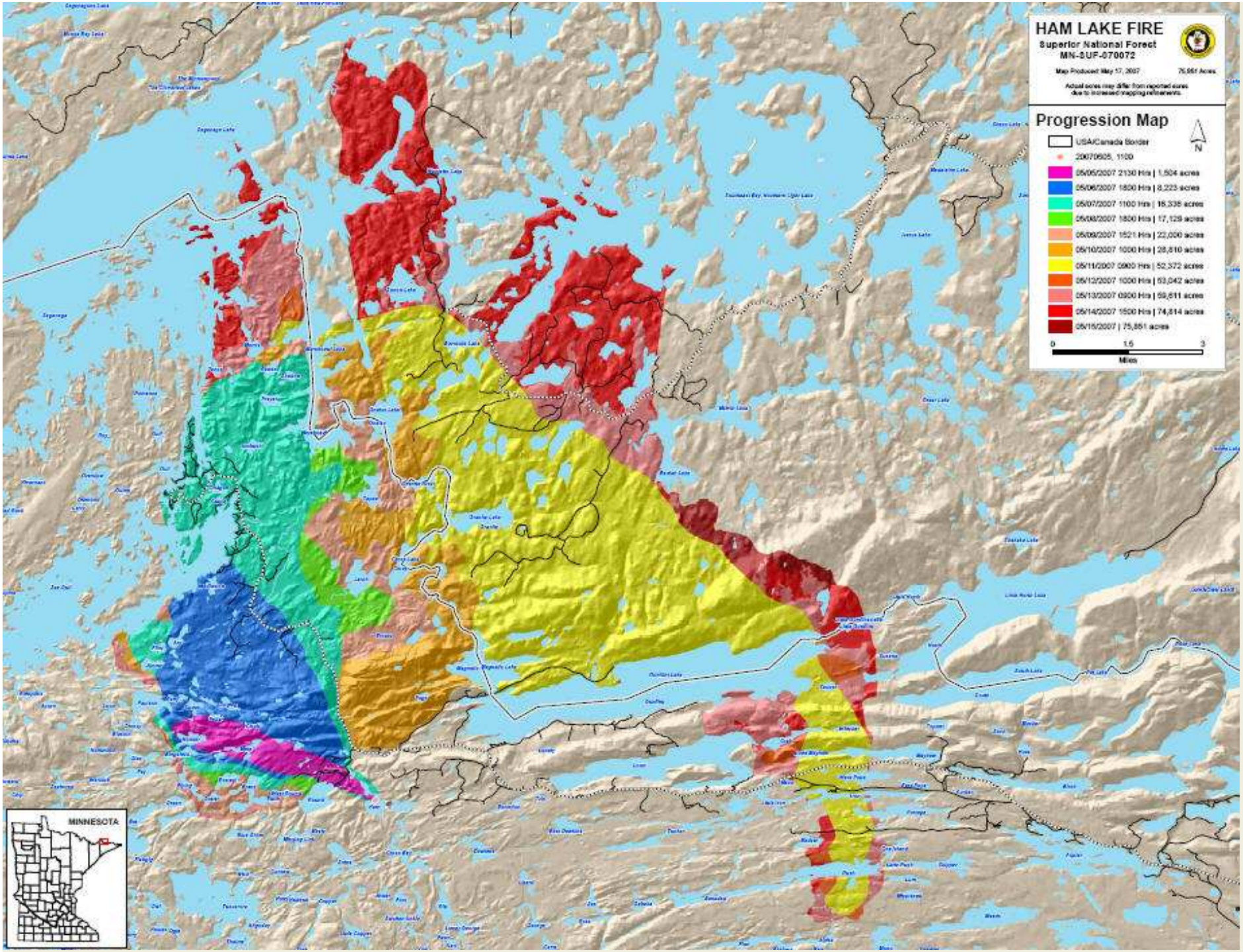
Cavity Lake Fire making its big run on July 16, 2006

Cavity Lake Burn, Seagull Lake, July 2007. Photo: Dave Hansen, University of MN

Cavity Lake Burn, Seagull Lake, July 2007. Photo: Dave Hansen, University of MN

Roy and Nick, Cavity Lake Burn, Seagull Lake, July 2007. Photo: Dave Hansen, University of MN

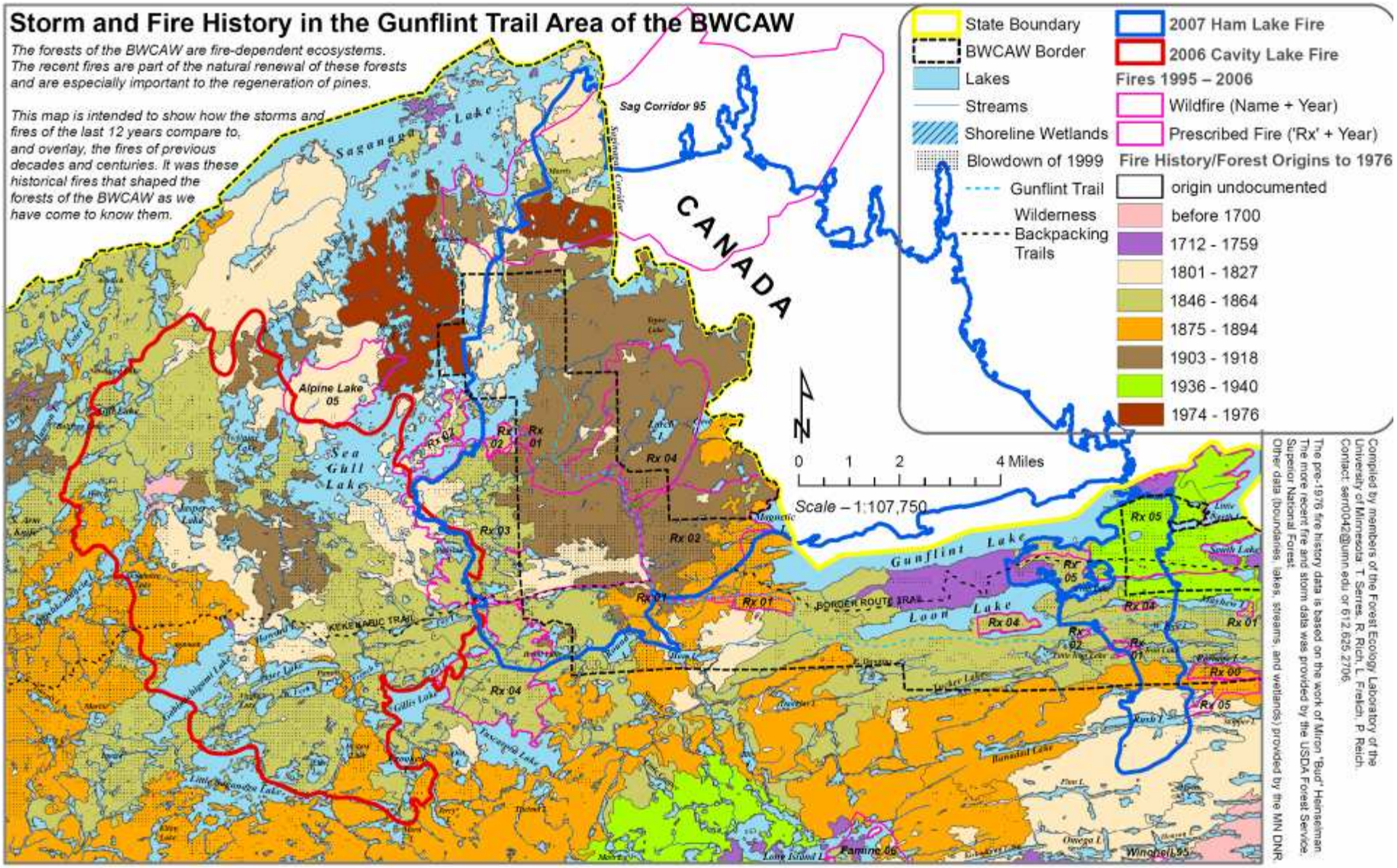
Nick and Roy, Cavity Lake Burn, Seagull Lake, July 2007. Photo: Dave Hansen, University of MN


HAM LAKE FIRE
Superior National Forest
MN-SUF-070072
Map Produced: May 17, 2007
75,851 Acres
Actual acres may differ from reported acres due to increased mapping refinements.
Progression Map
N
USA/Canada Border
20070505, 1100
05/05/2007 2130 Hrs | 1,504 acres
05/06/2007 1800 Hrs | 8,223 acres
05/07/2007 1100 Hrs | 16,338 acres
05/08/2007 1800 Hrs | 17,129 acres
05/09/2007 1521 Hrs | 22,000 acres
05/10/2007 1000 Hrs | 28,810 acres
05/11/2007 0900 Hrs | 52,372 acres
05/12/2007 1000 Hrs | 53,042 acres
05/13/2007 0900 Hrs | 59,611 acres
05/14/2007 1500 Hrs | 74,814 acres
05/15/2007 | 75,851 acres
0
1.5
3
Miles
MINNESOTA

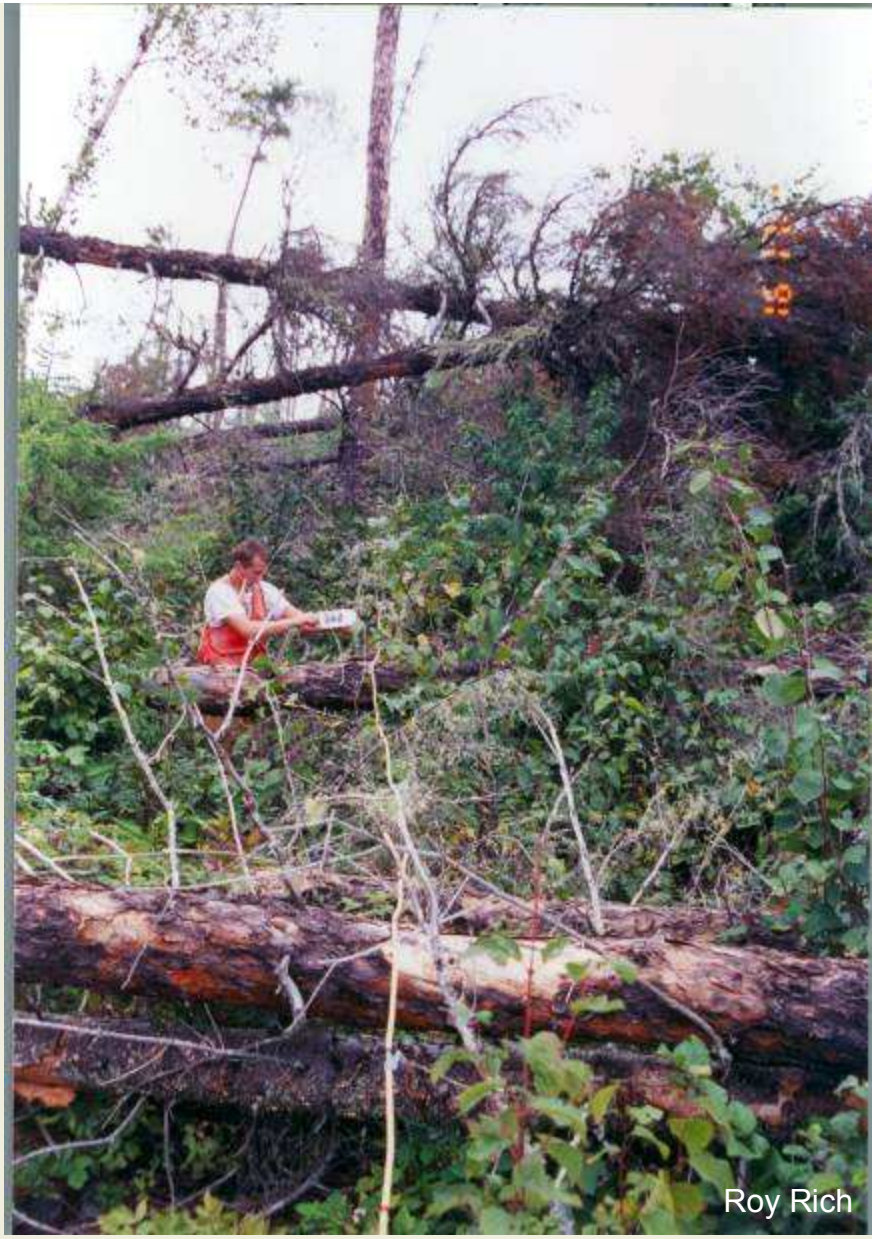
View of Ham Lake Fire from Seagull Palisades—midnight May 6, 2007. Layne Kennedy (left) and Gus Axelson (Right).

Ham Lake Burn, Gunflint Trail, July 2007. Photo: Dave Hansen, University of MN

Ham Lake Burn, Gunflint Trail, July 2007.
Photo: Dave Hansen, University of MN

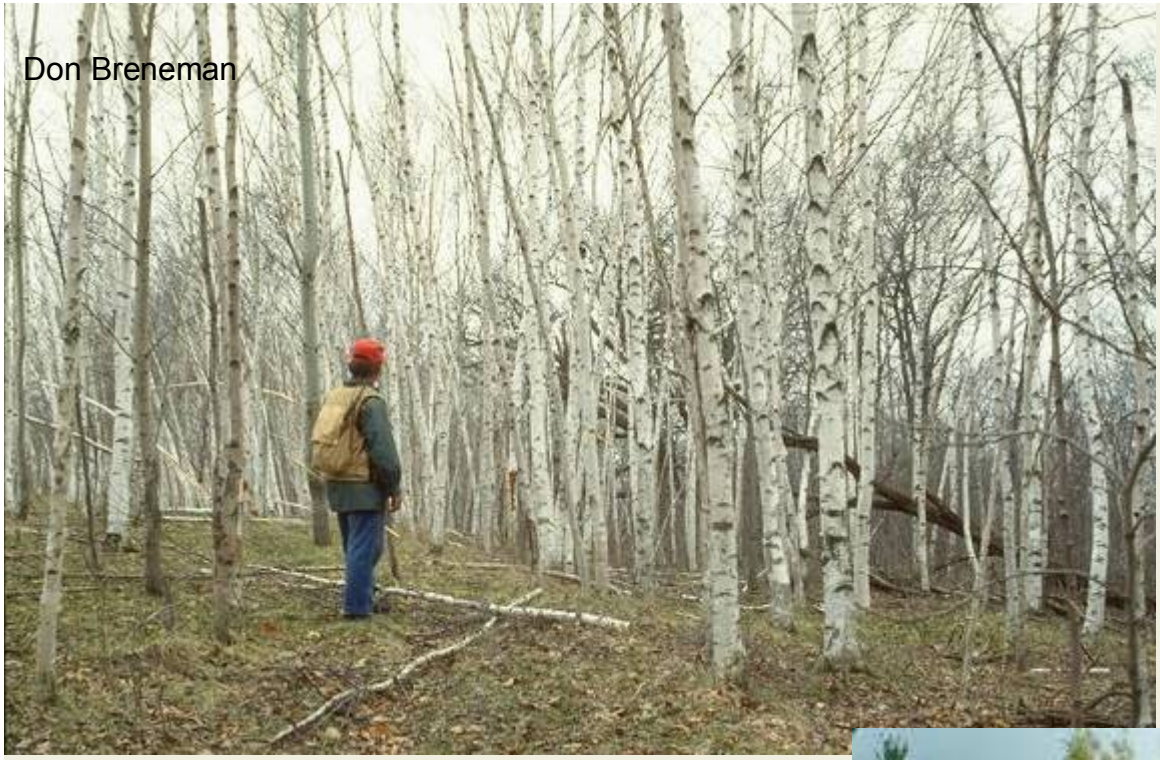


Complex disturbance histories in the Gunflint/Seagull Lake Area



200 year old red pine forest before and after 1999 blow down

The same forest as previous slide after 2002 prescribed burn and as of July 2007


Don Breneman

Looking 10-15 years into the future


Lee Frelich

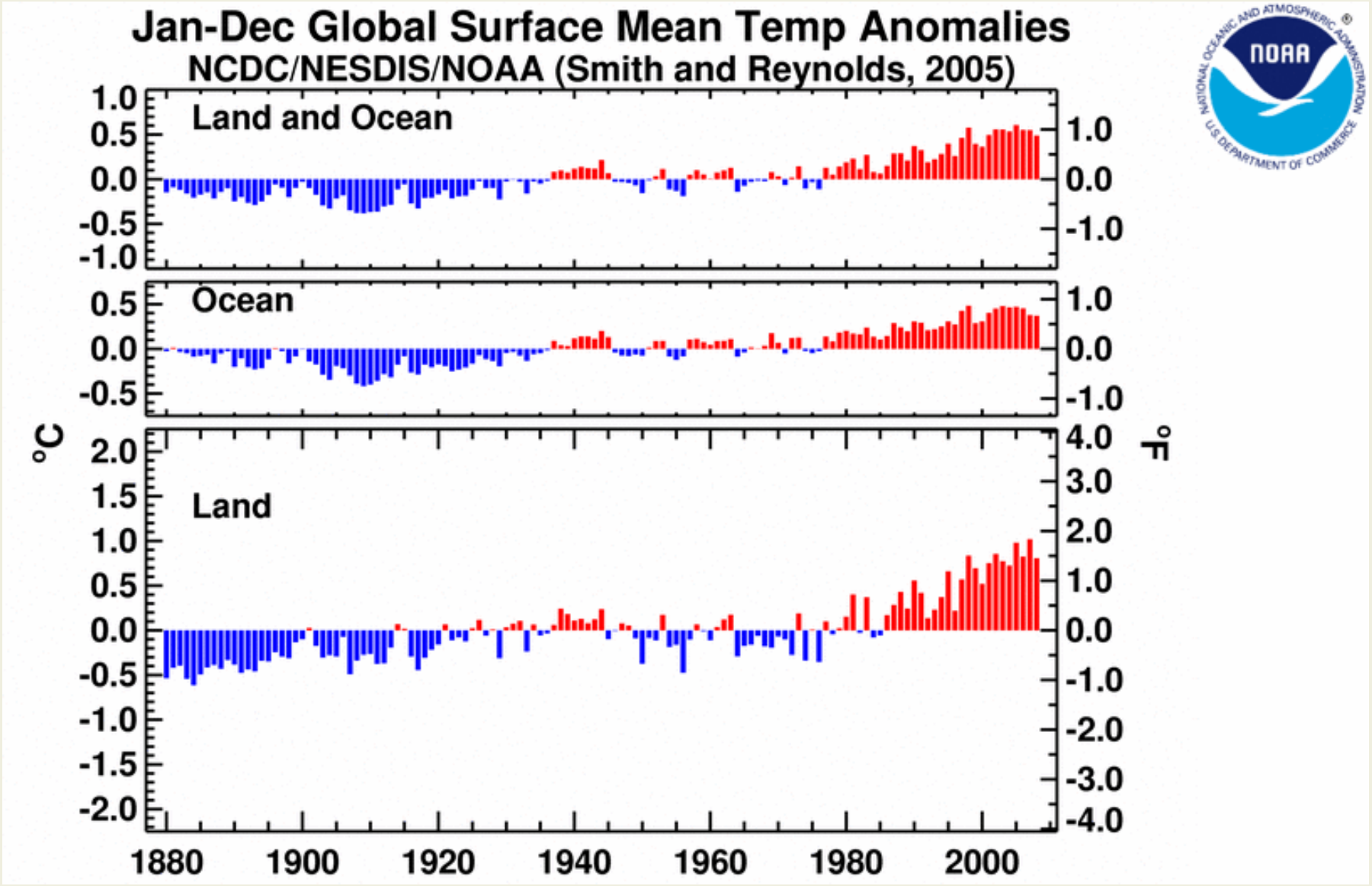
The past (left) and future, (right) forests

Bud Heinselman

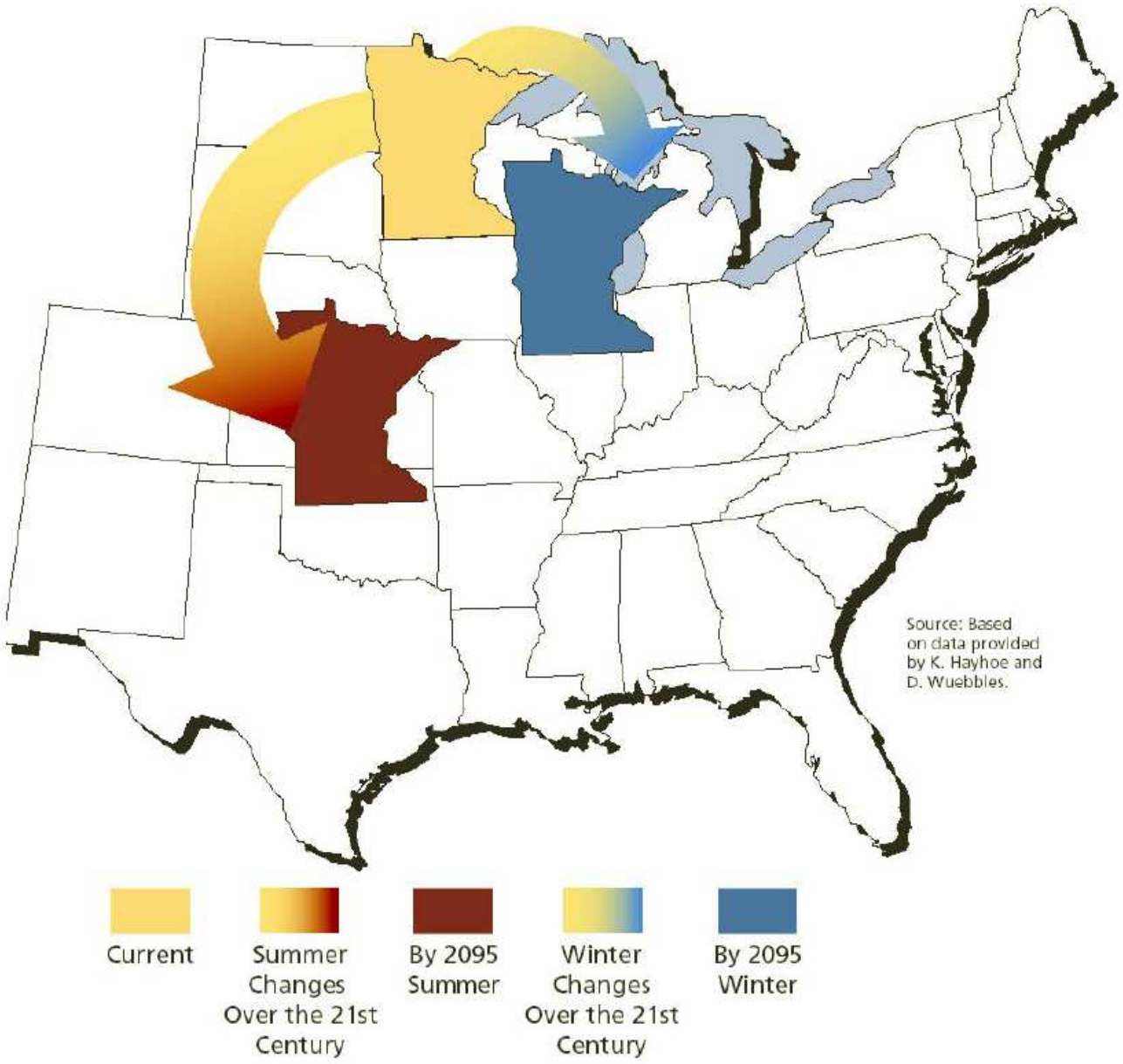
Lee Frelich

Svante August Arrhenius
(Nobel prize, Chemistry,1903)

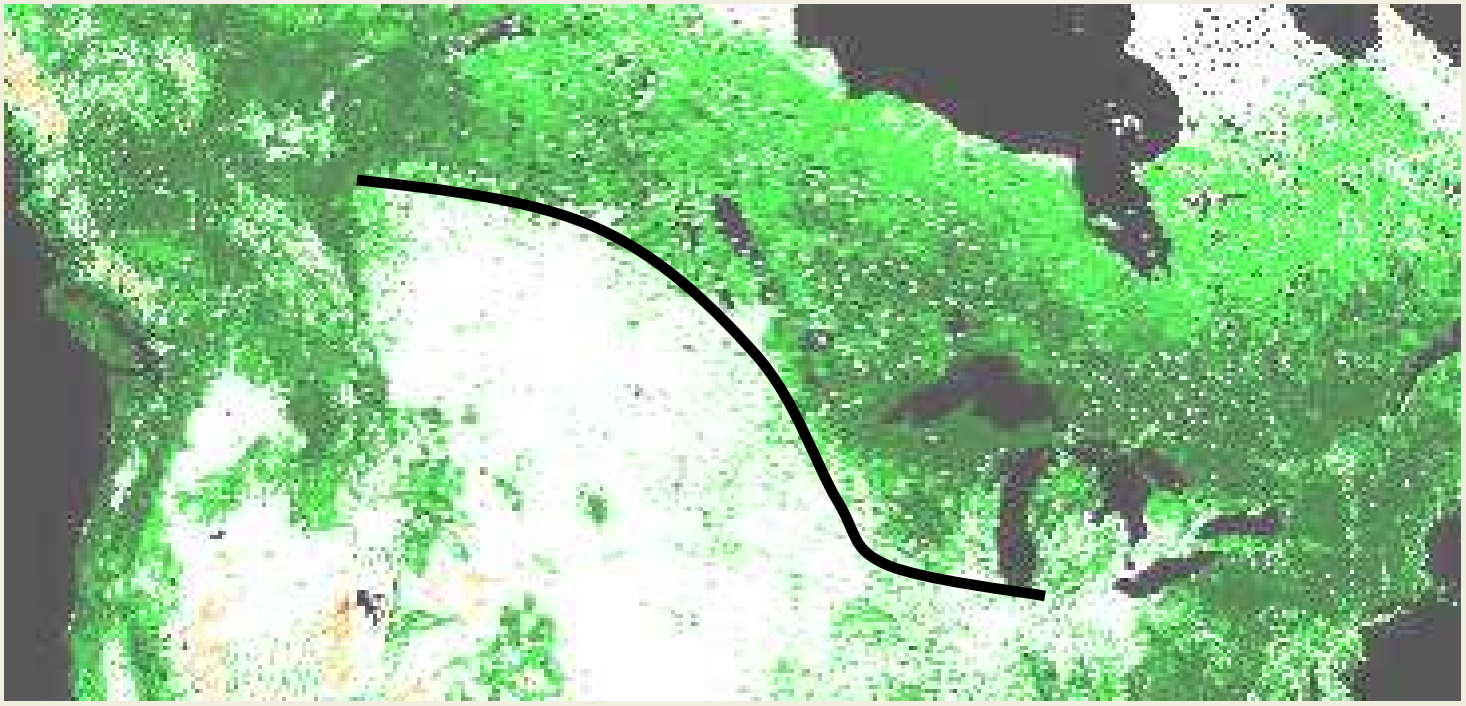
Developed the hothouse theory for CO_2 in 1896, and in 1905 predicted that raising CO_2 content of the atmosphere would cause an increase in mean global temperature similar in magnitude to modern predictions


Jan-Dec Global Surface Mean Temp Anomalies
NCDC/NESDIS/NOAA (Smith and Reynolds, 2005)
Land and Ocean
Ocean
Land
°C
°F
1.0
0.5
0.0
-0.5
-1.0
2.0
1.5
-1.5
-2.0
4.0
3.0
2.0
-2.0
-3.0
-4.0
1880
1900
1920
1940
1960
1980
2000
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

MINNESOTA


Source: Based on data provided by K. Hayhoe and D. Wuebbles.
Current
Summer Changes Over the 21st Century
By 2095 Summer
Winter Changes Over the 21st Century
By 2095 Winter

Birch dieback, North Shore, 2008. Photo: Dave Hansen.



Forest cover of central North America (green)

DeFries, R., M. Hansen, J.R.G. Townshend, A.C. Janetos, and T.R. Loveland (2000), 1 Kilometer Tree Cover Continuous Fields, 1.0, Department of Geography, University of Maryland, College Park, Maryland, 1992-1993.

It is possible that the pbf will move 500 km to the north and east, deforesting an area 2X the size of California

Photos: Roy Rich

Savanna of bur and northern pin oaks

Photo: Dave W. Peterson

Overall scheme for change at the prairie-forest border proposed by Frelich and Reich