

Natural Resources Research Institute

To foster economic development of Minnesota's natural resources in an environmentally sound manner to promote private sector employment

- Two Centers

- Center for Applied Research and Technology Development
 - Center for Water and the Environment

- CARTD

- Mining and Economic Geology
 - Peat/Environmental Processing
 - Forestry and Forest Products



NRRI Forestry Program

Mission: To enhance the economy of rural Minnesota through high-quality applied forestry research

Focus on applied silviculture in cooperation with practitioners – industry, public agencies

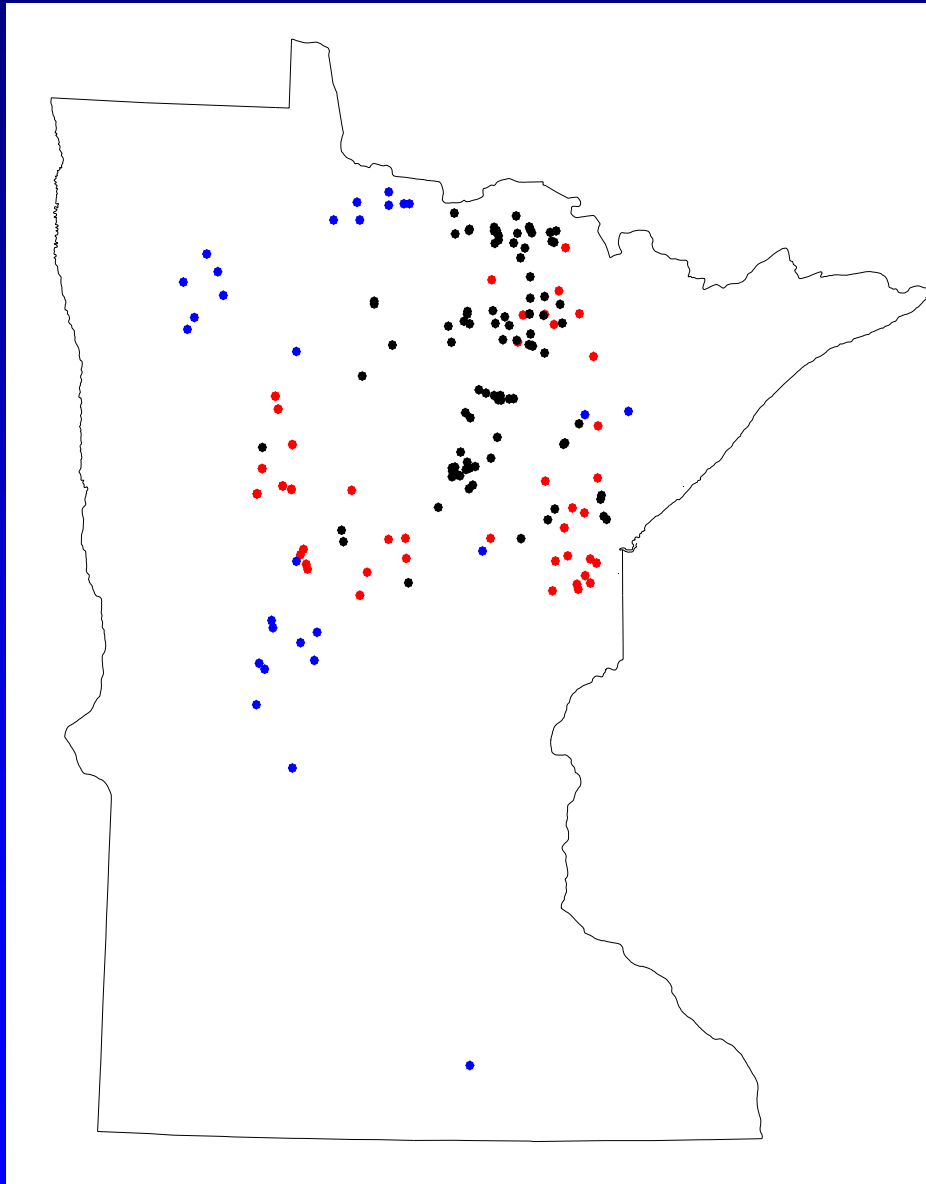
Five staff – foresters, plant breeder, horticulturist

NRRI Forestry Program

Research Areas:

- Hybrid Poplar
- Aspen Productivity and Silviculture
- Plantation Production of Conifers
- Biomass Energy

NRRI Research Sites



- Aspen Sites
- Norway Pine
- Hybrid Poplar Sites

Current Energy Prices

Fuel	\$/unit	unit	\$/mmbtu	efficiency	net cost
Natural Gas	\$7.80	mmbtu	\$7.80	0.9	\$8.66
Heating Oil	\$1.71	gallon	\$12.30	0.85	\$14.47
Propane	\$0.92	gallon	\$10.11	0.9	\$11.23
Round Wood	\$75.00	cord	\$3.83	0.6	\$7.35
Wood Chips	\$25.00	gr. ton	\$2.94	0.6	\$4.90
PRB Coal	\$10.00	ton	\$0.57	0.6	\$0.94

Red Pine Productivity and Silviculture Research



NRRI Red Pine Research

- establish a baseline productivity dataset on commercially-managed lands
- determine responses to thinning in thinned stands on MFPRC members lands
- establish focused research to supplement existing knowledge base
- assist in transfer of knowledge

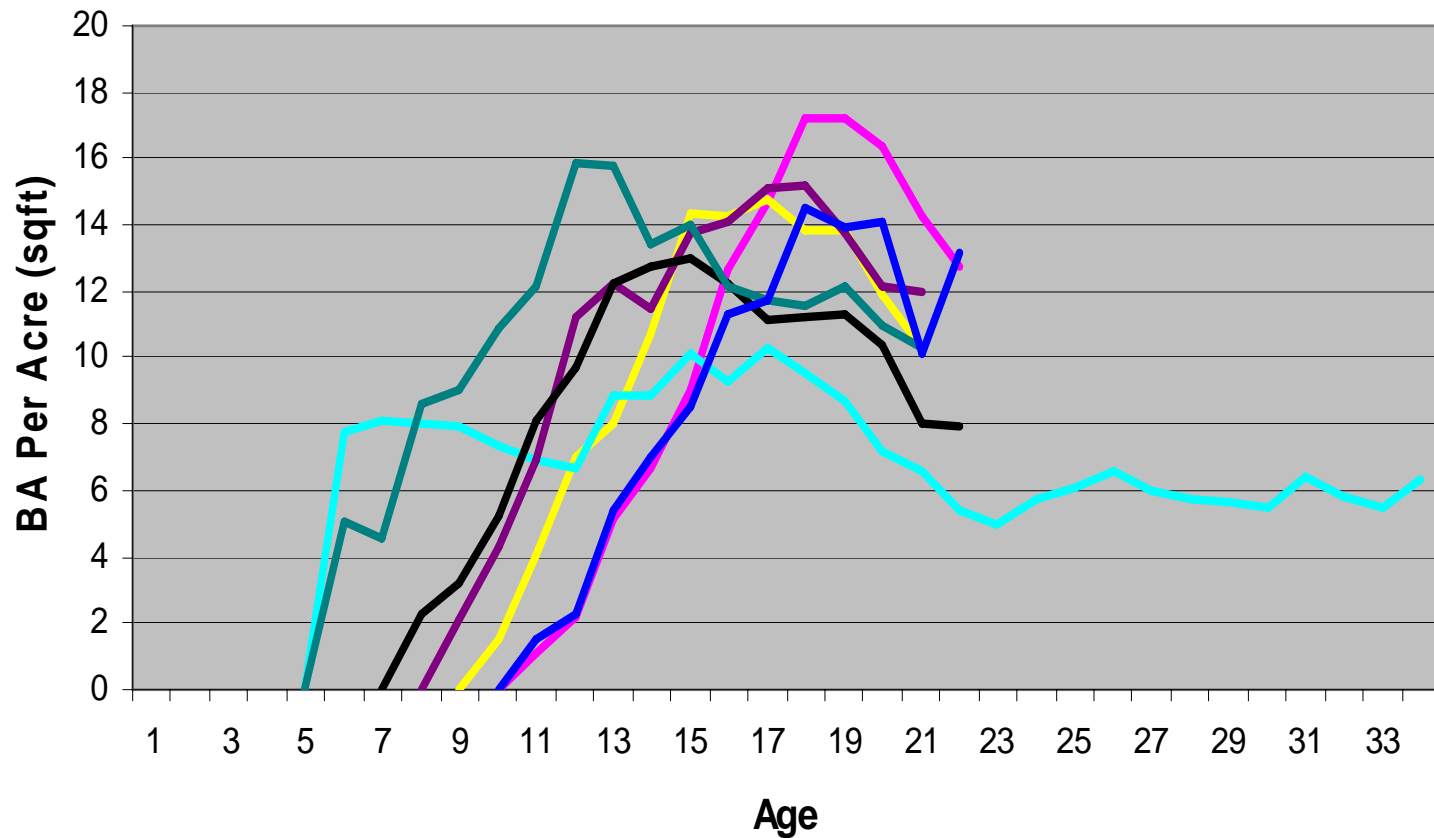
Red Pine Productivity



- radial growth increment by size class to reconstruct past growth patterns
- use plot data to determine BA and volume per acre, back that down using cores

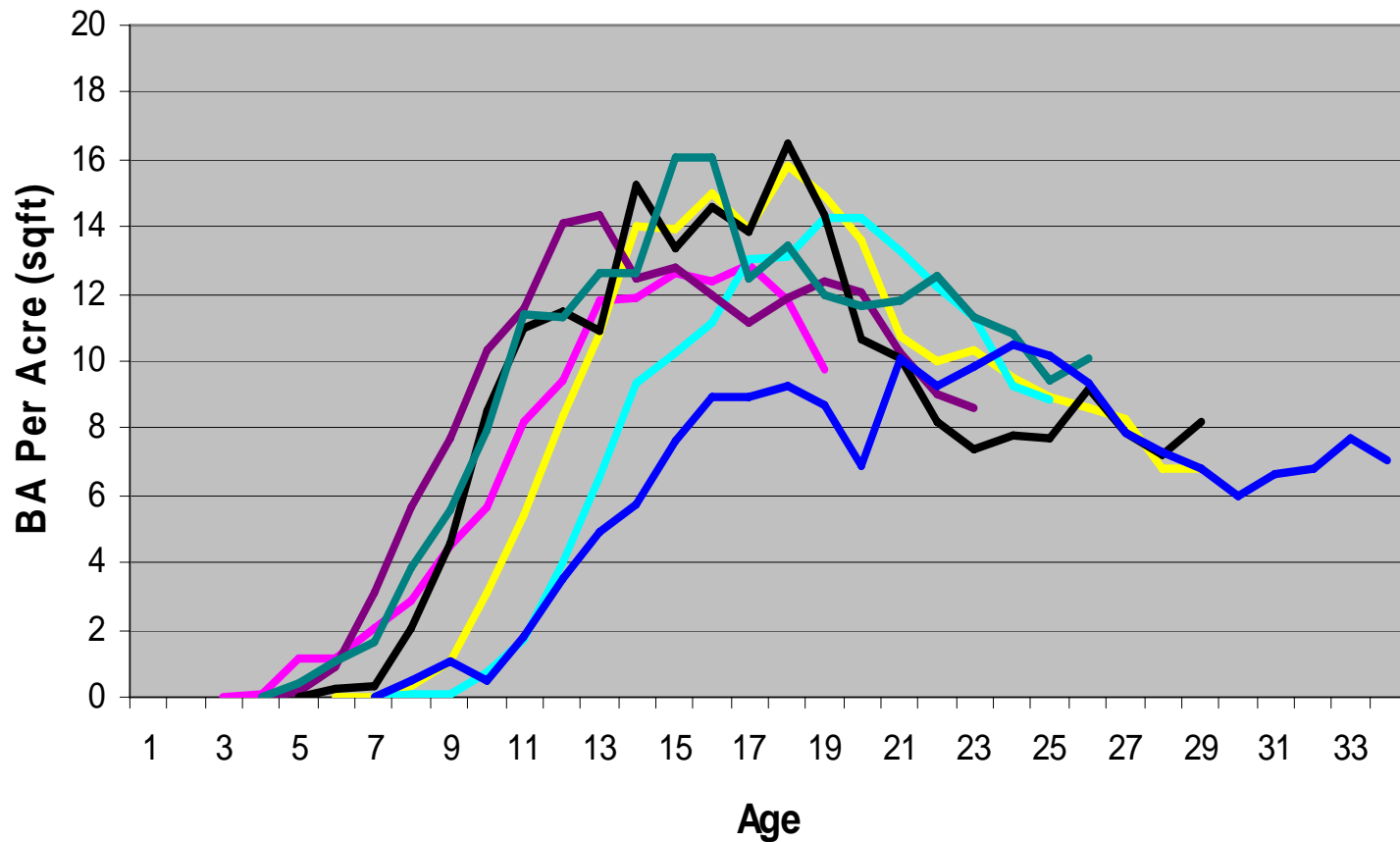
Unthinned Plantation Growth – PAI BA

West Central Minnesota
Red Pine Growth - BA per Acre

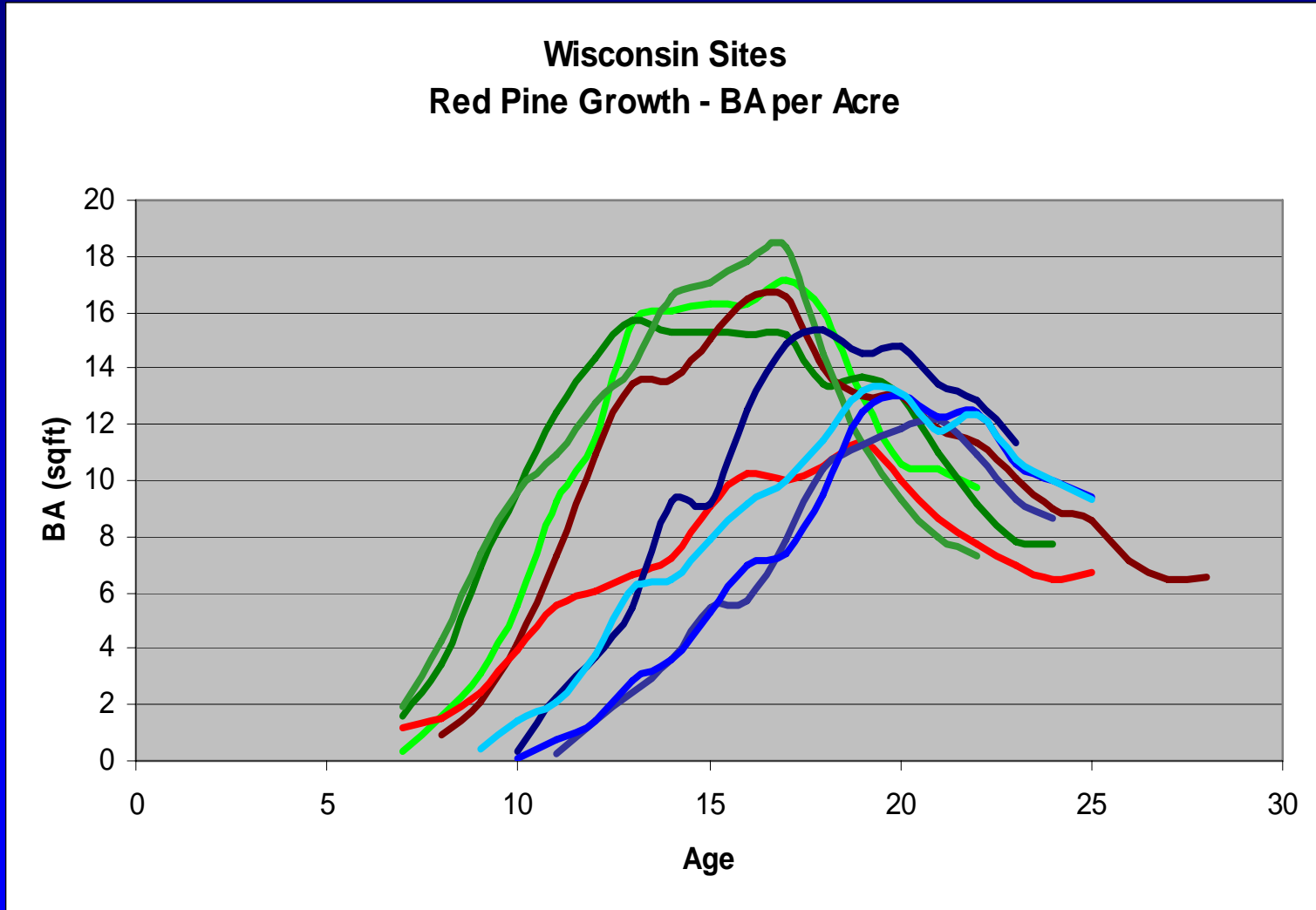


Unthinned Plantation Growth – PAI BA

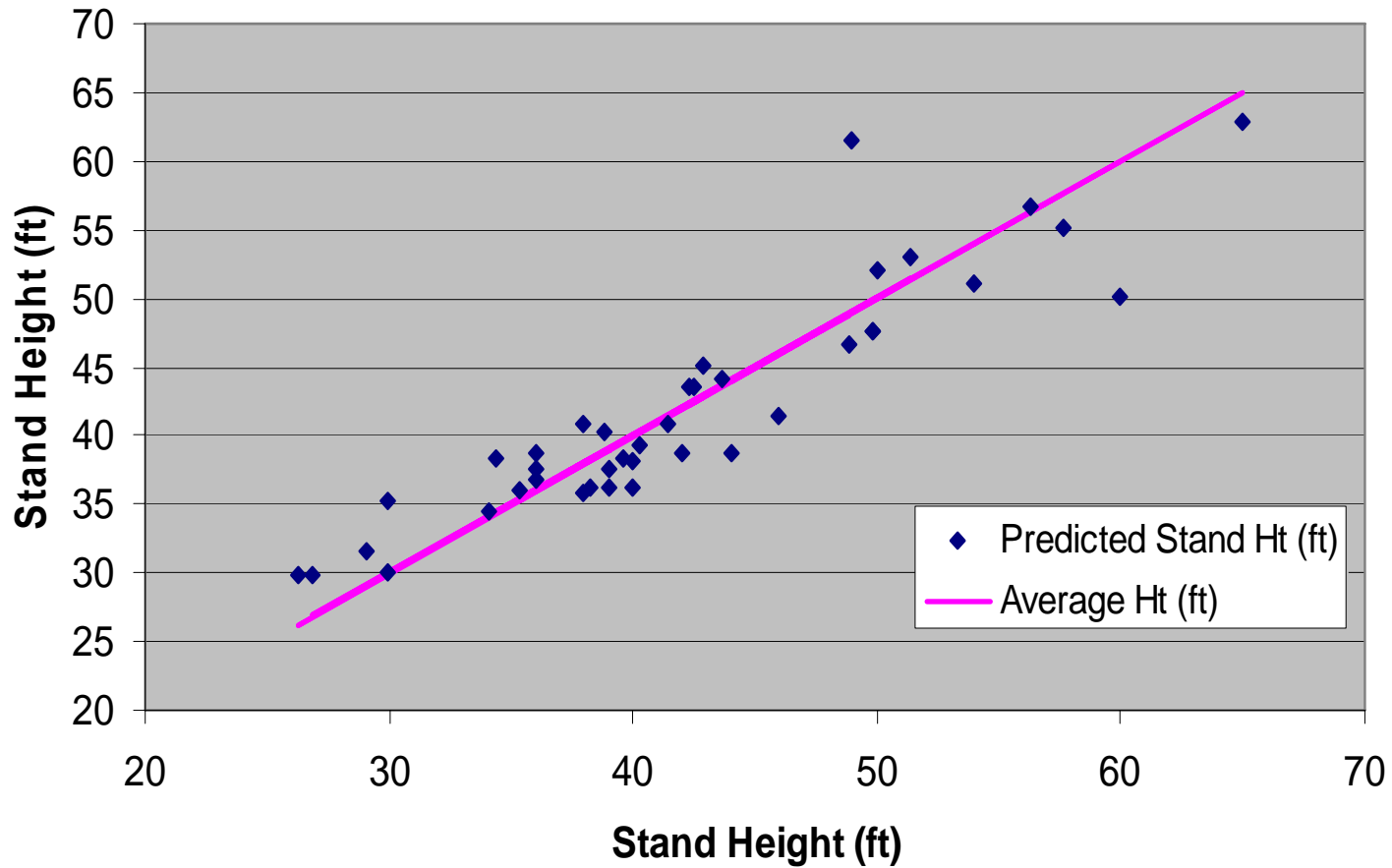
Northern Minnesota
Red Pine Growth - BA per Acre



Unthinned Plantation Growth – PAI BA



1:1 Fit of Stand Height on Stand Age and Breakout Age



- age and breakout age explain 84% of SI
- two outliers removed – 91%

Red Pine Multi-Treatment Thinning Studies

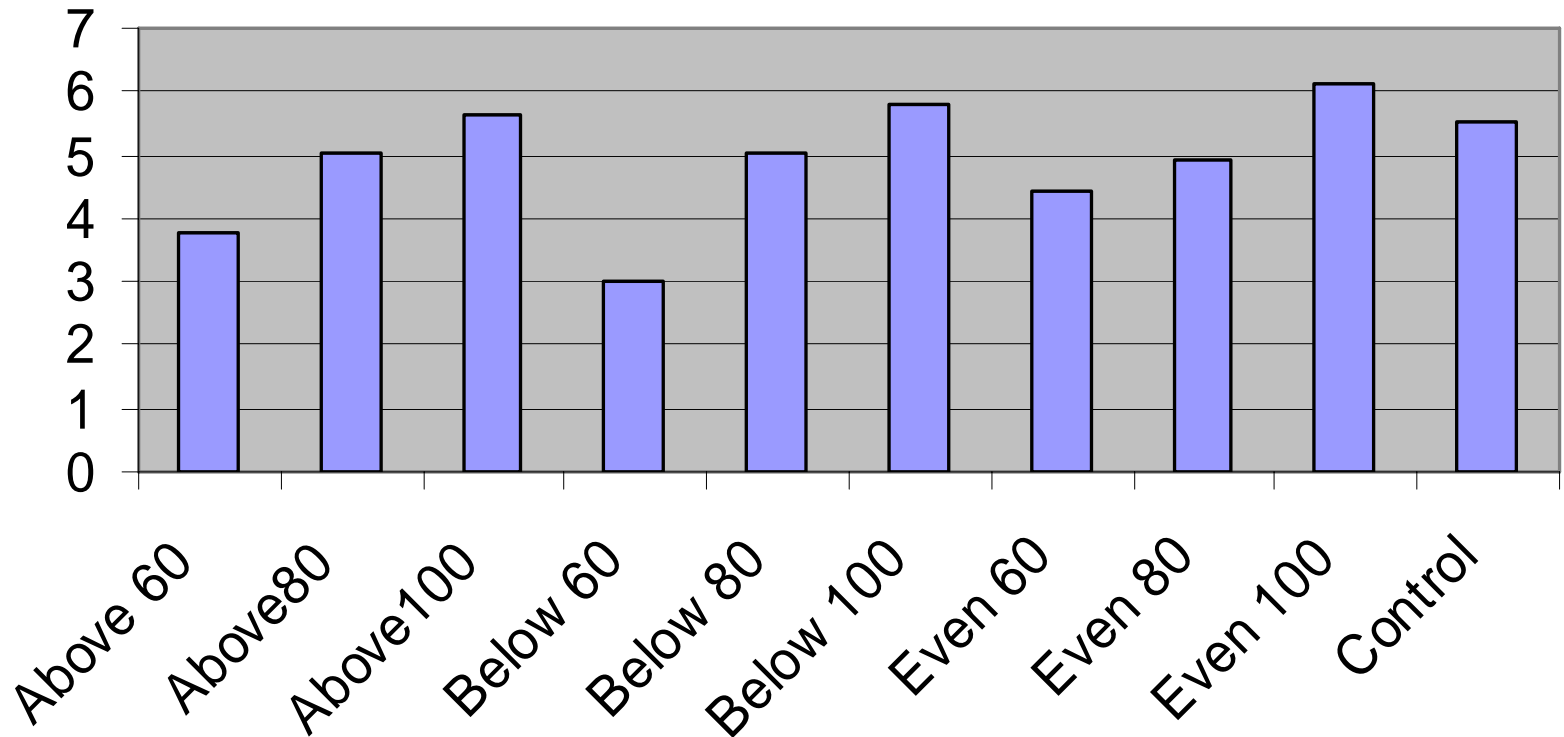
Work began in 2006/2007

- **4 sites completed**
- **6 more sites will be completed by spring of 2008**
- **study design: 3 replications by 10 treatments**
- **treatments: thinned to 60 , 80, 100 sq.ft of basal area with 3 thinning methods; above, below, even-diameter + control**
- **all thinning treatments have every 5th row removed**

Multi-Treatment Thinning Studies

Potlatch Willow River Red Pine Thinning Trial

2006 BA Increment (sqft/acre)



Bottom Line - Red Pine Silviculture and Productivity

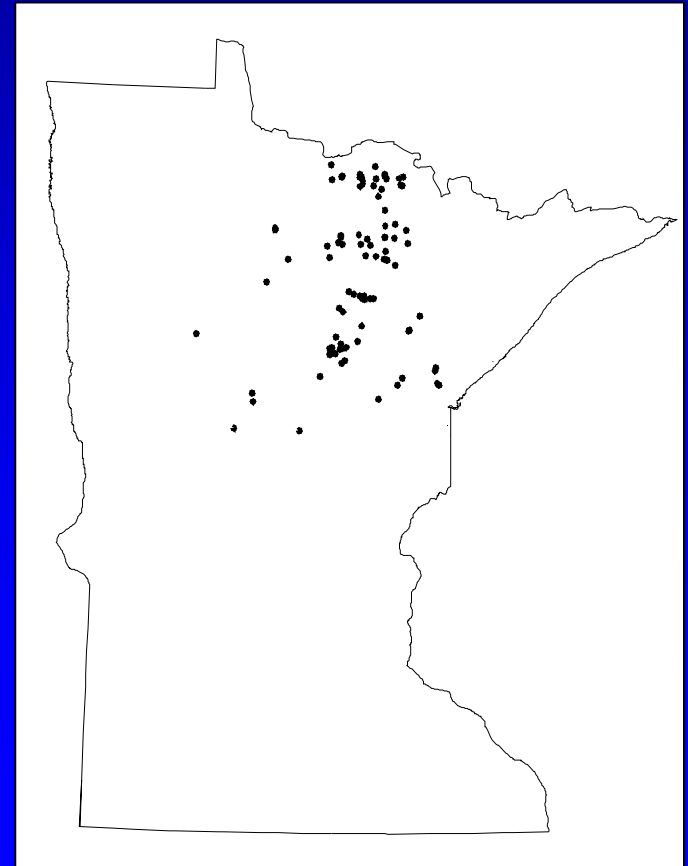
- control early competition – hit DBH by age 4 to 5
- most stands capable of hitting 180 to 200 sq.ft. by a stand age of 24
- intensive early competition control coupled with thin-from-above will have obvious impact on economics
- results of our work allow accurate estimations of total stand volume at first thinning – sawtimber, pulp and wood for energy

NRRI Aspen Productivity Research

- are second-growth stands higher-yielding than past?
- effects of assumptions about future aspen stand volume on timber availability
- developing stand stocking relationships – quantifying relative stand density
- analysis of the effect of stand attributes on productivity
- incremental growth and stand dynamics

NRRI Aspen Dataset

- 133 stands in analysis to date from MN and WI
- age range 18 – 40
- typically 20 1/100 acre plots per stand



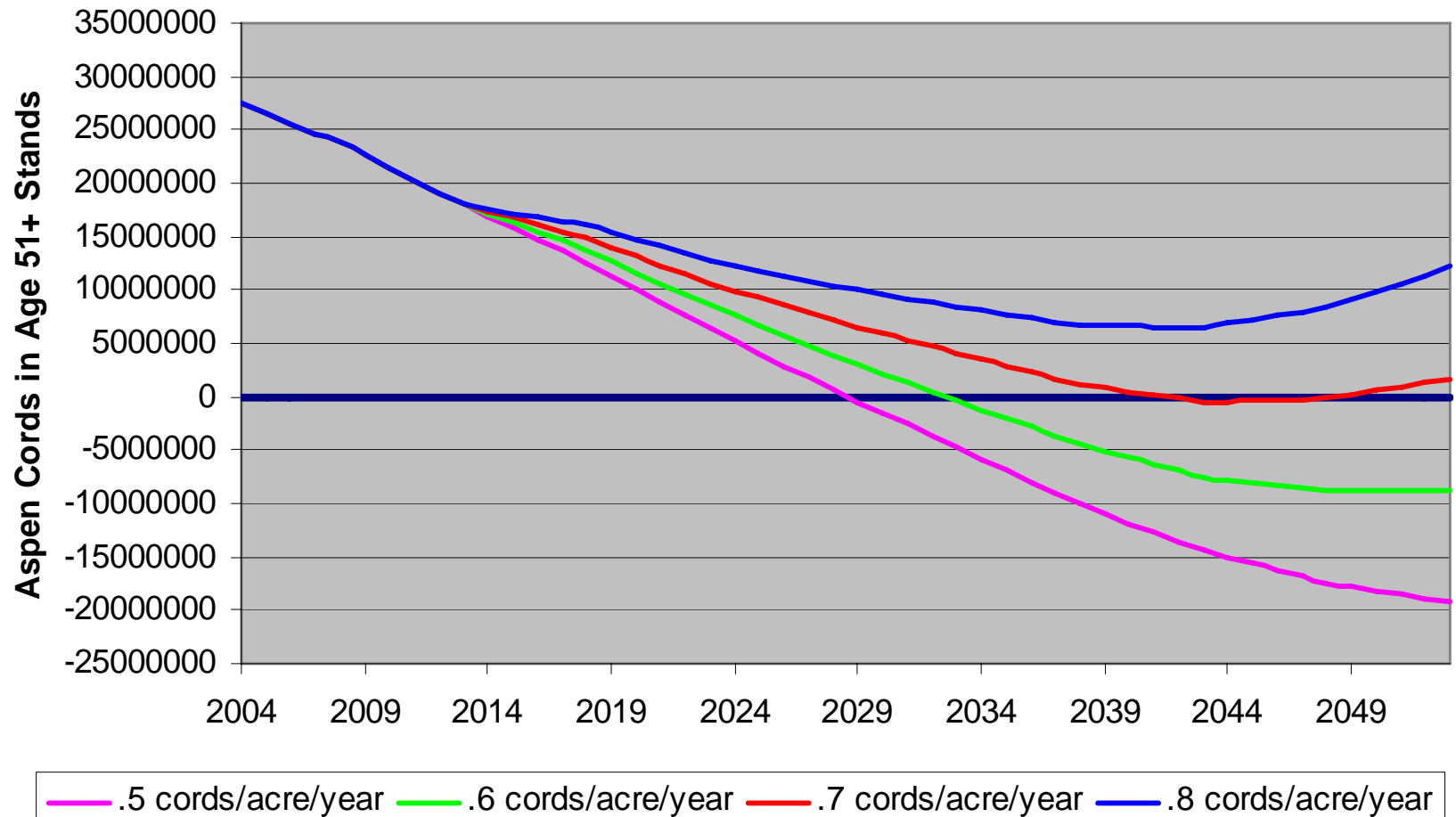
Aspen Productivity Data Summary

Cords per Acre Equivalents

Age	Stems/ Acre	Total Volume Bole wood + Tops and Limbs	5.25 Dbh 3inTop Volume	6.0 Dbh 3inTop Volume
20	1846	12.6	3.8	2.0
25	1291	23.0	11.6	7.9
30	893	29.6	18.2	13.4
35	824	42.0	30.4	26.1

Projected Aspen Availability – NRRI

Projected Minnesota Aspen Supply Assuming Various Future Productivity Rates and a 2.6 Million Cord Annual Harvest Level



Aspen Strip Thinning

Network of 9 sites established in 1989/1990

Strip thinning treatments

- control
- 4 ft leave strip and an 8 ft thinned strip



Results from 2005 measurements

Treatment	Start Age	Ending Age	Mean Dbh(in)	Total Volume Bole wood + Tops and Limbs Cords/Acre equivalents	Percent Growth
Control	11	27	4.4	27.7	89%
Thinned	11	27	4.9	24.7	

Treatment	Start Age	Ending Age	Mean Dbh(in)	5.25 Dbh 3in Top Volume Cords/Acre	Percent Growth
Control	11	27	6.1	11.9	118%
Thinned	11	27	6.4	14.1	

Treatment	Start Age	Ending Age	Mean Dbh(in)	6.25 Dbh 3in Top Volume Cords/Acre	Percent Growth
Control	11	27	6.7	7.7	124%
Thinned	11	27	7.1	9.5	

Hybrid Poplar

What is it?

Section AIGEIROS

Populus deltoides Eastern cottonwood (USA)

Populus nigra Black cottonwood (Europe)

Section TACAMAHACA

Populus trichocarpa Black cottonwood (USA)

Populus maximowiczii Asian poplar (Japan, China, Korea, Russia)

Current Plantation Acreage in Minnesota

- approximately 25,000 acres of hybrid poplar
- approaching 20,000 acres by Verso Paper, target 25,000
- most planted in two clones selected through NRRI/USFS research (DN34, NM6)

NRRI Hybrid Poplar Research

Genetic Improvement

- critical to long-term success
- one of the largest and most successful

breeding programs in North America

Plantation Management

- weed control
- plant spacing
- fertilization

Genetic Improvement Program

- collection and screening of new parent material
- hybridization to produce new clones
- screening of existing clones (pre-existing the MHPRC)
- screening of output of breeding program
- long-term approach – requires a minimum of 8 years to deliver a new clone from scratch

Populus Parent Improvement

- 2005 OP *P. deltoides* (35 seedlots-MN R.)
- 2005 OP *P. nigra* (45 seedlots – from 8 EUFORGEN PN Network countries)
- 2005 & 2006 OP *P. trichocarpa* (interior northern Idaho & coastal Oregon)
- 2005 OP *P. maximowiczii* (Oji Paper Co., Hokkaido, Japan)

1996-2006 *Populus* Breeding

first-generation (F1) intra- & inter-specific hybridization attempts

Spp. Type	1996 & 1997	1998	1999	2000 & 2001	2002	2003	2004	2005	2006	Totals
DxD	43	40	6	18				24	30	161
DxM	4	16	28	32	8					88
DxN	4	7	28	38	7	12	12	26	24	158
DxT			9		10	12	12	30		73
NxM								6	20	26
N x other								19		19









Field Screening of New and Existing Clones in Minnesota

- 17 study sites screening output from NRRI breeding program for a total of 5600+ new clones being tested
- 6 sites with yield blocks and clone trials of selected clones from our initial field screening studies
- 14 sites with clone trials and yield blocks of existing clones from other programs



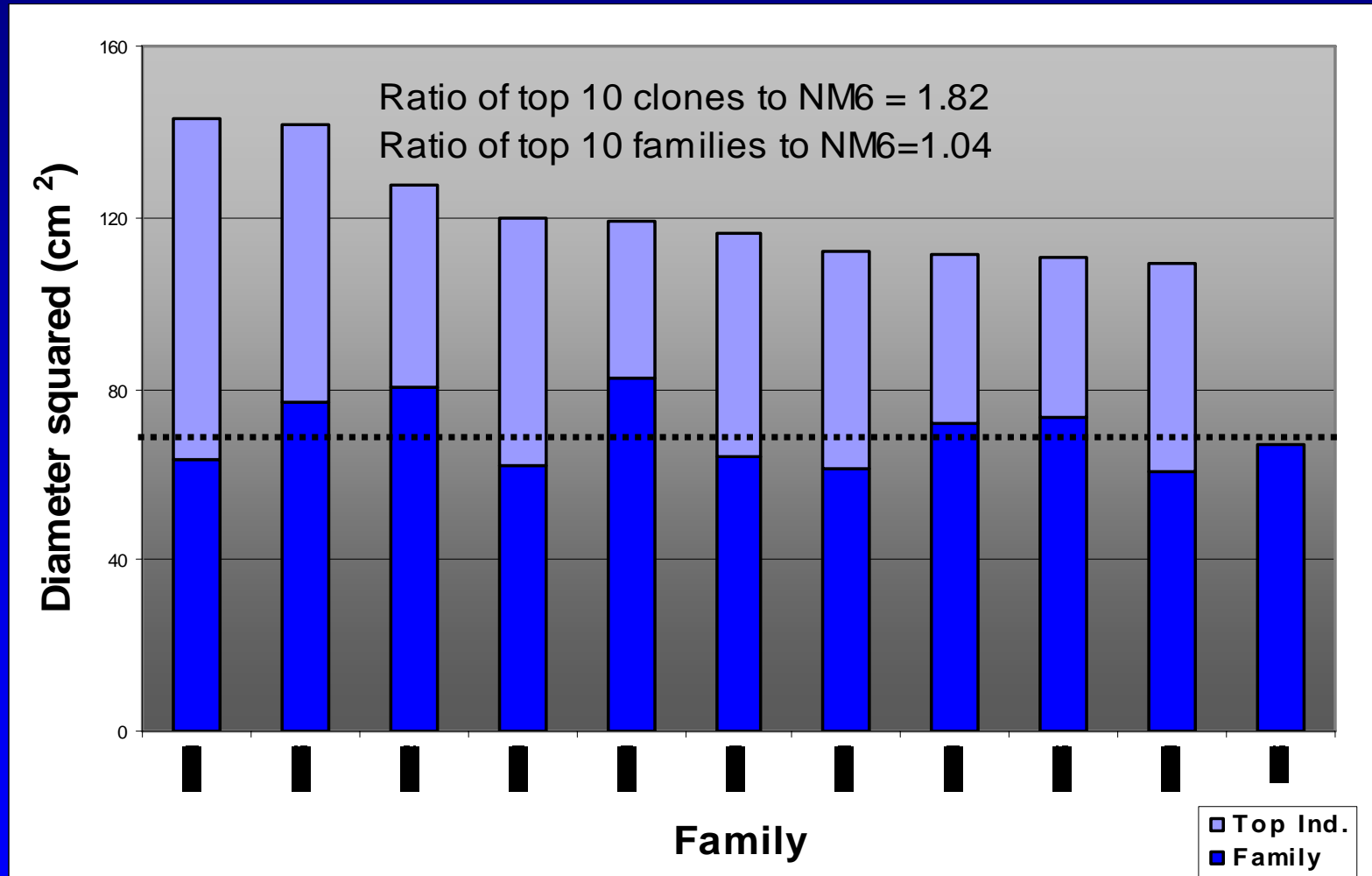






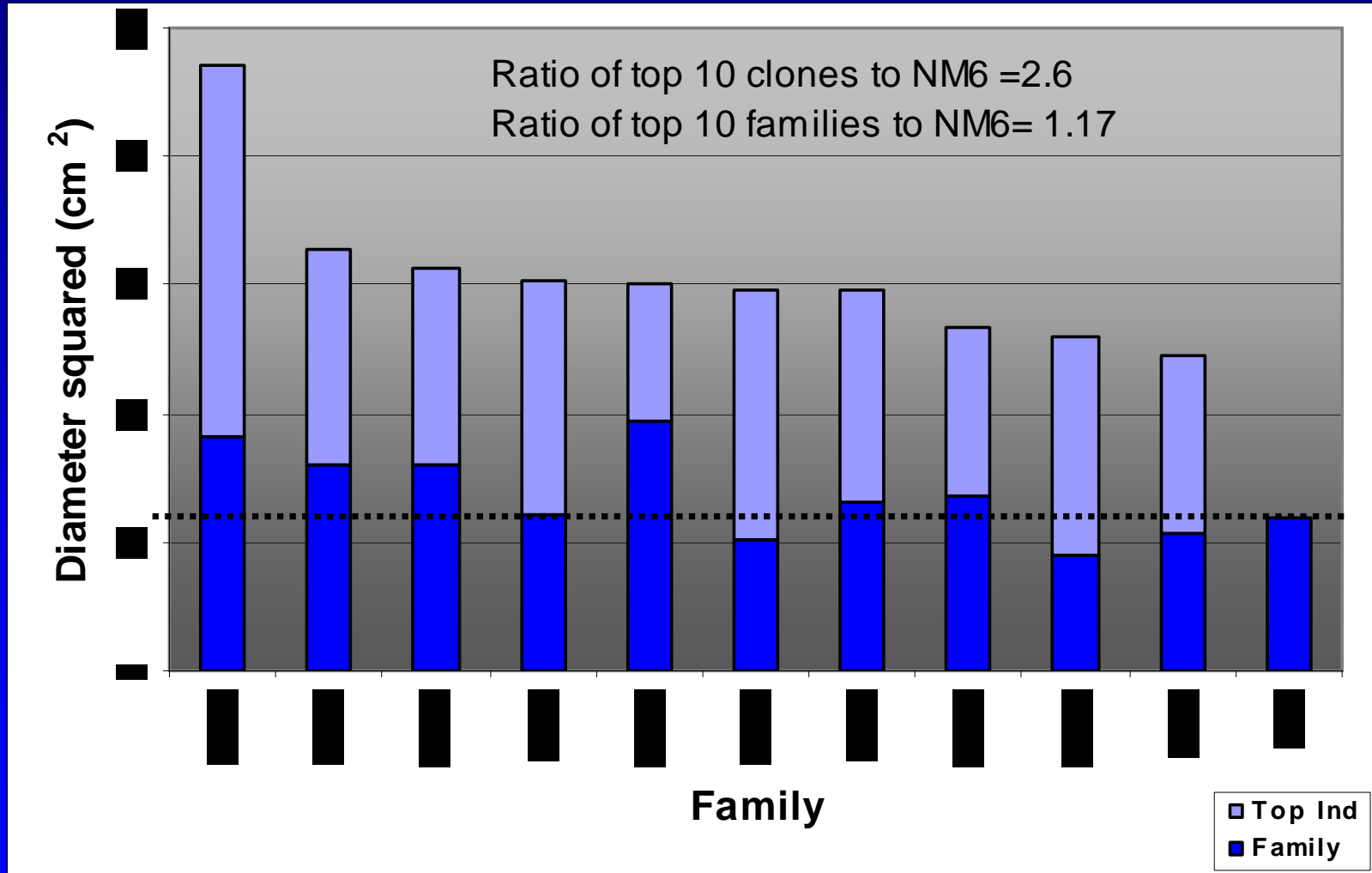


Central Minnesota 5 Year-Old Family Field Test



Ratio of ten highest-yielding clones to NM6 is 1.8

Central Minnesota 4 Year-Old Family Field Test



Ratio of ten highest-yielding clones to NM6 is 2.6

Harvesting Forest Residues

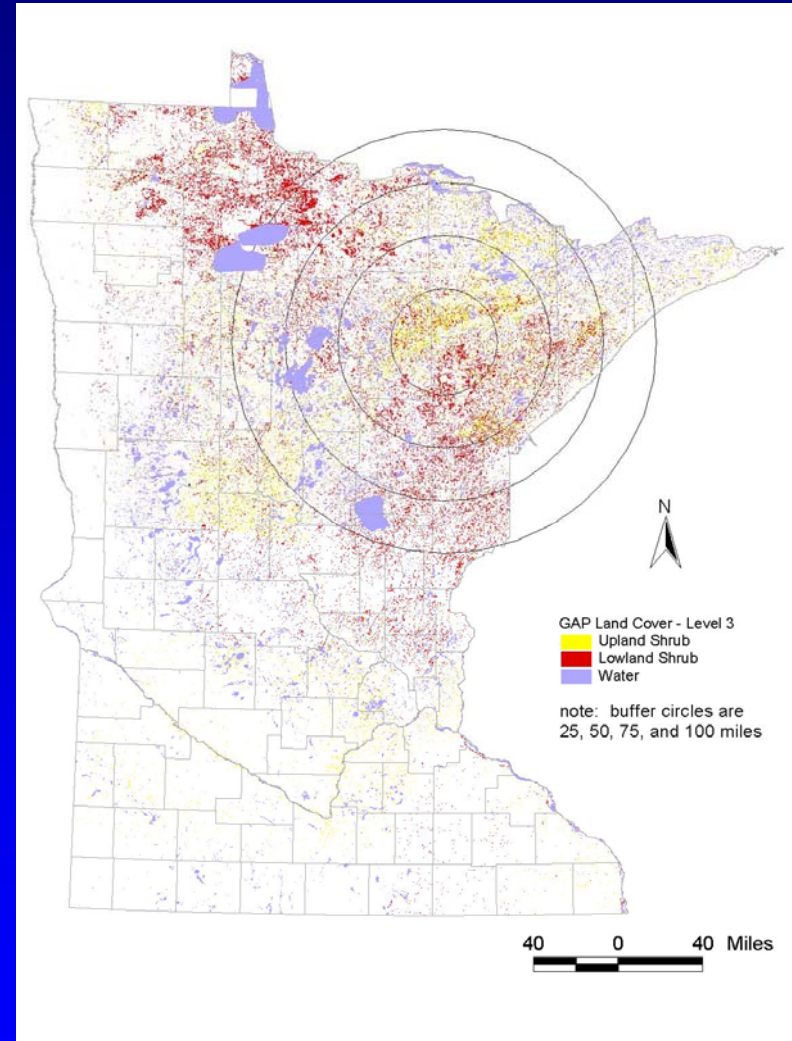


Issues Related to Harvesting of Forest Residues

- land management policies – cost and sale administration
- environmental concerns – nutrient removal and wildlife
- logistic and equipment – logger owned chipper or process after roundwood harvest
- equipment cost – utilization rate of logger-owned chippers is limited by the daily output of the logging operation
(chipper only runs 1 to 2hrs maximum per day)



Brushland Resource and Harvesting



With the new energy markets we will have greater opportunities and flexibility to manage our forest and utilize all species of trees as well as forest residues.



For more information contact:

Bill Berguson at bberguso@nrri.umn.edu or Dan Buchman at dbuchman@nrri.umn.edu