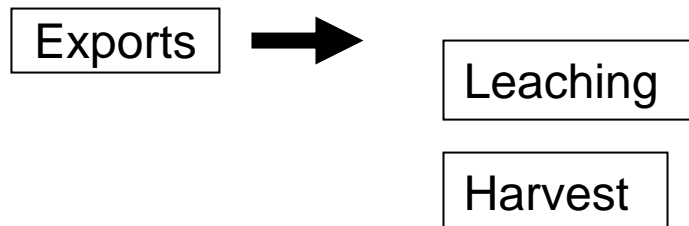
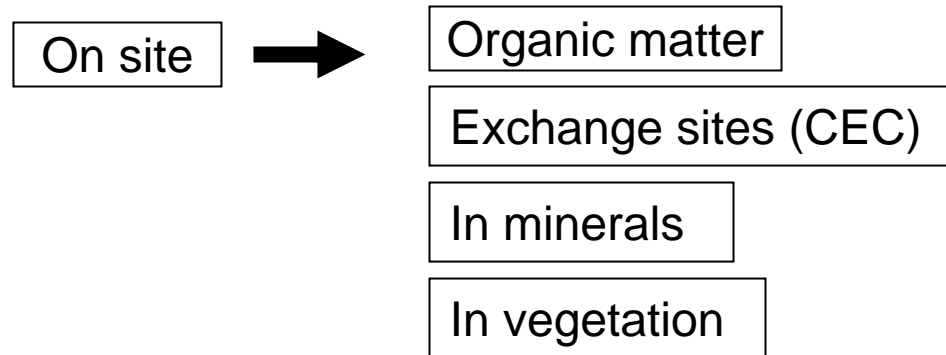
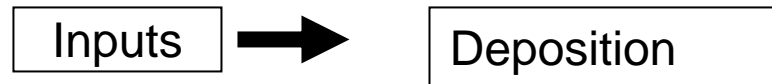


Woody Biomass Site Impacts

Nutrient Pools



Nutrients

- Calcium
- Magnesium
- Potassium
- Nitrogen
- Phosphorus

Soils Bases (Ca, Mg, K)

- Most likely to have problems
- Removed from site with logs
- More removed with biomass harvest than normal logging

Storage in trees

- K and Mg- leaves and branches
- Ca- also bark (wood is <1%, bark can be 2 or 3%)

Grigal 2004 GEIS Update and
Bockheim (UWM) research was
used for much of this data

In Vegetation

- Conifers
 - 250 lbs/acre Ca
 - 30 lbs/acre Mg
 - 150 lbs/acre K
- Hardwoods
 - 600 lbs/acre Ca
 - 50 lbs/acre Mg
 - 200 lbs/acre K

Total on site (Grigal 2004)

Ca

3000-15000 (lbs/a)

Mg

700-3700 (lbs/a)

K

195-1900 (lbs/a)

Bosman et al. 2001,

Keays 1975,

Grigal 2004

Potential Problem Sites

- Most likely
 - Organic soils for K and P (from Grigal 2004)
- Outwash sands (low nutrient holding capacity) with high nutrient demanding species (aspen/northern hardwoods)
- Shallow soils over bedrock (small amount of rooting medium)

Goals

- Intro to soil impacts
- Intro to use for precommercial thinning
- Intro to slash harvest
- Intro to use for fire control

Biologically, why pre-commercial thinning

- Growth on higher quality trees.
- Reduces rotation or increases tree size
- Increases tree vigor
- Removes trees that will die anyway

Why it isn't done

- Costs with no immediate benefit
- Time
- Some species do not self-prune well

Aspen

Number of aspen sprouts per acre after clearcut

Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
4500	1620	13400	11700	10500	8900	7700

Example Aspen Coppice 15 year old

- 1362 TPA
- 43 sf BA
- 2.4 QMD

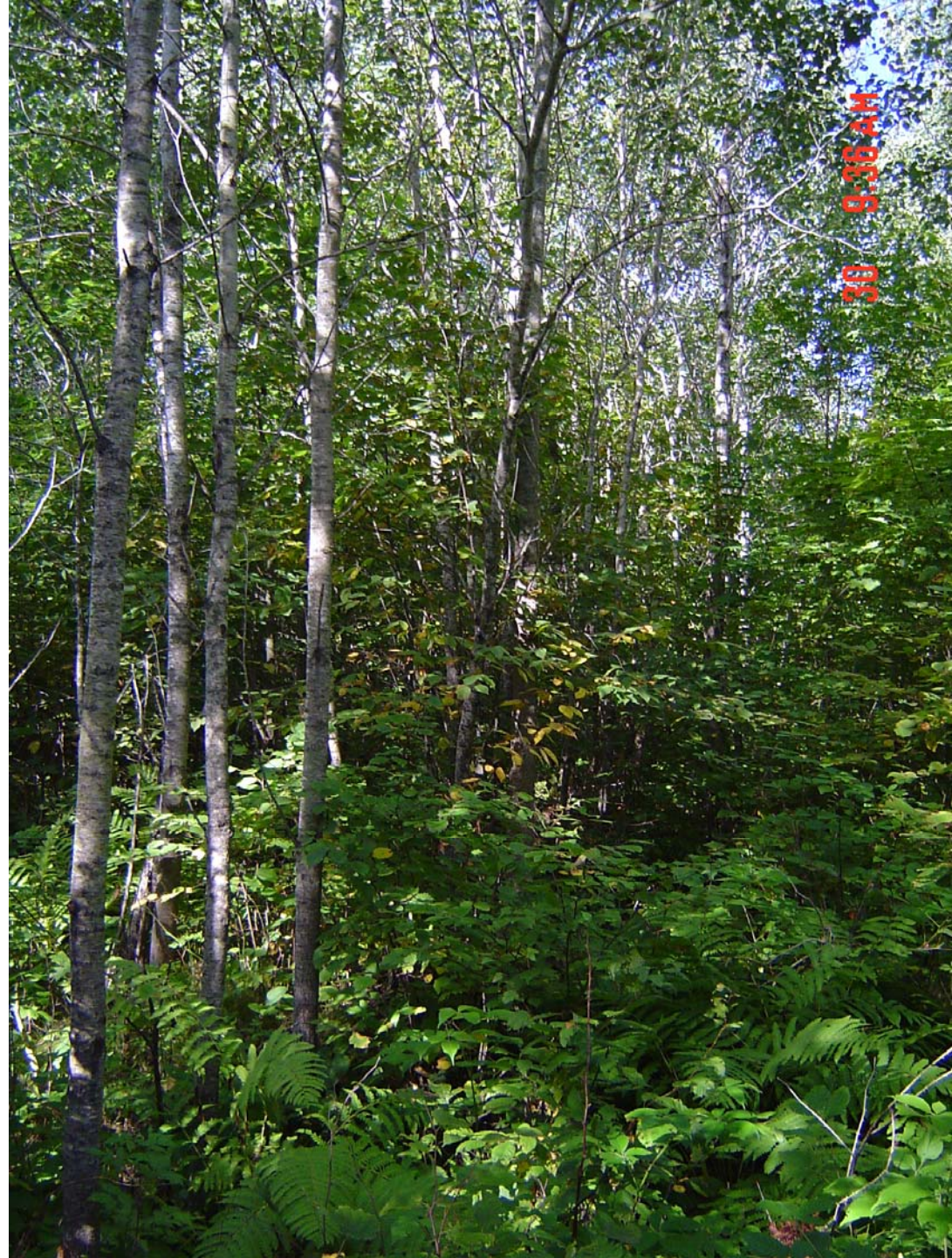
- This is a fairly normal stand of aspen

Potential Pre-commercial Thinning

- Bulldozer
- Brush cutter
- Crusher
- ???

Precommercial thinning

- First thin to 550 stems per acre (10 year to now)
- Second thin at age 30 to 200 stems per acre
- Research shows that thinning can increase total rotation yield by 40% (Perala 1978)



Species: ALL Year: 2006 Mgmt Id: NONE Stand: s

-----LIVE TREES-----							-----HARVESTED TREES-----					
DIAM. CLASS	TREES PER ACRE	AVG HT	BASAL AREA	TOTAL CU FT	MERCH CU FT	MERCH BD FT	TREES PER ACRE	AVG HT	BASAL AREA	TOTAL CU FT	MERCH CU FT	MERCH BD FT
2	916.7	20.3	20.0	0.0	0.0	0.0	812.4	20.3	17.7	0.0	0.0	0.0
4	445.6	28.7	23.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1362.4	23.0	43.3	0.0	0.0	0.0	812.4	20.3	17.7	0.0	0.0	0.0

Biomass in the Aspen

Number	Size	kg	lbs	Total
812	2 inches	5.113302	11.24927	9134.403

This stand had about 4.5 tons dry weight of total pre-commercially removed biomass all too small for pulpwood

Formula used is =EXP(-2.2094+2.3867*LN(5))

Precommercial thinning

- First thin to 550 stems per acre (10 year to now)
- Second thin at age 30 to 200 stems per acre
- Research shows that thinning can increase total rotation yield by 40% (Perala 1978)

Thin 15 years later

Number	Size	kg	lbs	Total
98.6	4 inches	26.74052	58.82913	5800.553
267.7	6 inches	70.3796	154.8351	41449.36

This stand had about 23.5 tons dry weight removed of which a portion is small pulpwood

Formula used is =EXP(-2.2094+2.3867*LN(5))



30 10:09 AM

Species: ALL Year: 2051 Mgmt Id: NONE Stand: s

-----LIVE TREES-----						
DIAM. CLASS	TREES PER ACRE	AVG HT	BASAL AREA	TOTAL CU FT	MERCH CU FT	MERCH BD FT
2	2184.1	7.9	3.1	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0
8	1.6	40.5	0.7	9.9	0.0	0.0
10	31.9	49.6	19.8	393.5	0.0	0.0
12	132.8	51.5	96.0	1996.8	752.6	3754.2
Total	2350.5	10.9	119.5	2400.3	752.6	3754.2

60 year old stand

Thinned

-----LIVE TREES-----						
DIAM. CLASS	TREES PER ACRE	AVG HT	BASAL AREA	TOTAL CU FT	MERCH CU FT	MERCH BD FT
2	0.0	0.0	0.0	0.0	0.0	0.0
4	34.7	28.1	4.3	0.0	0.0	0.0
6	97.8	28.6	14.9	0.0	0.0	0.0
8	70.9	44.5	29.6	468.5	0.0	0.0
10	230.4	45.7	114.5	1876.3	0.0	0.0
12	1.7	50.7	1.1	23.3	8.3	41.6
Total	435.5	40.3	164.5	2368.1	8.3	41.6

Not Thinned

Benefits and Problems

- End of rotation, about same amount of wood
- Wood is larger
- Part of the 30 year thinning is pulp
- May have increase issues of sunscald
- Will have fewer trees to “hedge bets”
- May be able to “capture mortality”

Questions

- Could this 15 year old material be economically harvested for biomass?
- The 30 year thinning is “commercial” but at least half of the material would normally be slash or too small
- Could this be more easily harvested for biomass?



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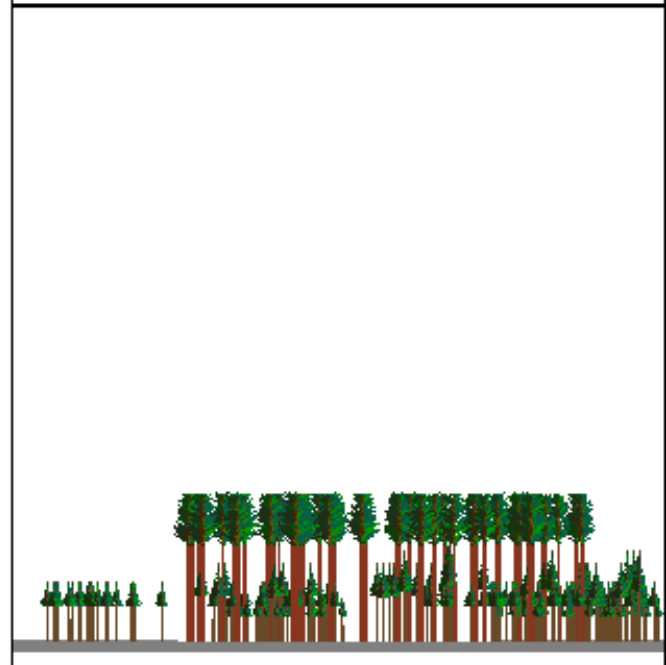
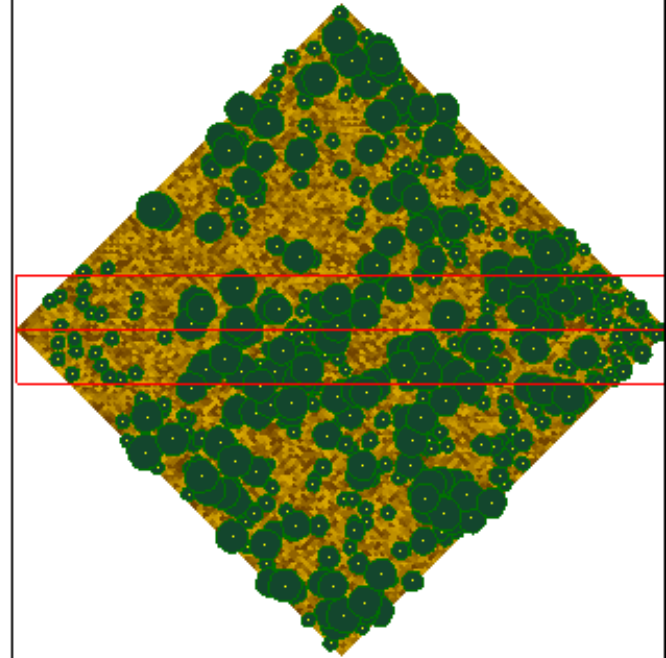
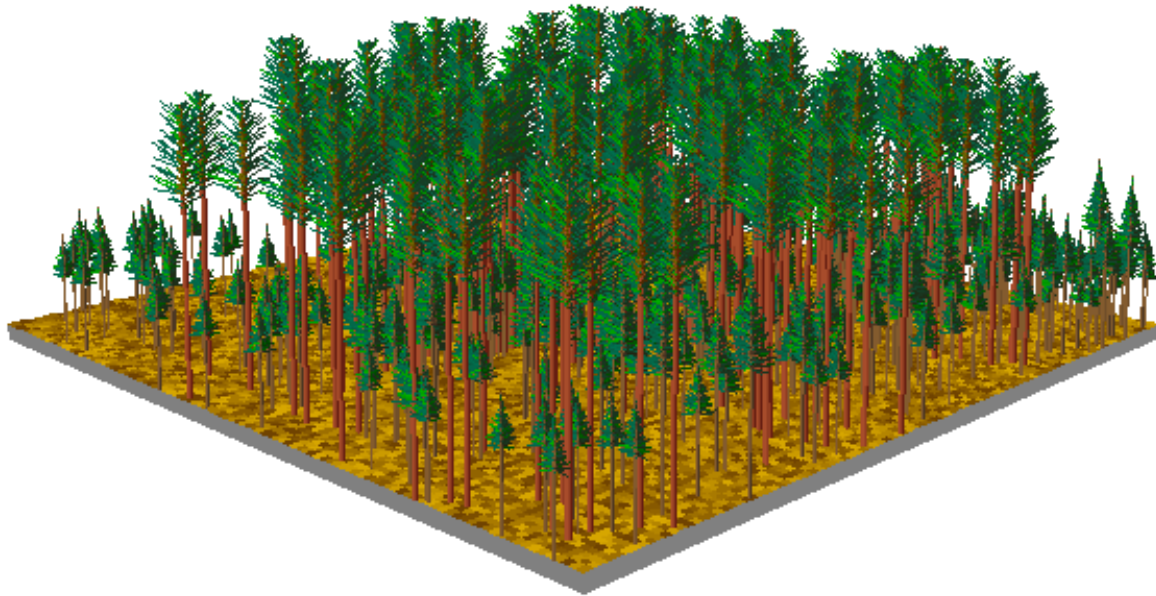
Red Pine with Balsam Understory

Red Pine with Balsam Understory



Stand=rp Year=2005 Inventory conditions

redpinebalsam_001.svs



Species: RP Year: 2005 Hgmt Id: NONE Stand: r1

-----LIVE TREES-----						
DIAM. CLASS	TREES PER ACRE	AUG HT	BASAL AREA	TOTAL CU FT	MERCH CU FT	MERCH BD FT
2	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
10	57.8	67.0	34.2	814.8	551.7	2324.3
12	98.3	67.0	75.0	2055.2	1447.3	6397.9
14	6.9	67.0	6.7	185.2	144.5	671.3
Total	163.0	67.0	115.8	3055.1	2143.5	9393.5

Species: BF Year: 2005 Hgmt Id: NONE Stand: r1

-----LIVE TREES-----						
DIAM. CLASS	TREES PER ACRE	AUG HT	BASAL AREA	TOTAL CU FT	MERCH CU FT	MERCH BD FT
2	75.0	19.0	1.5	0.0	0.0	0.0
4	316.8	28.8	18.1	0.0	0.0	0.0
6	26.8	42.9	4.2	35.2	0.0	0.0
8	3.1	51.5	0.8	13.1	0.0	0.0
Total	421.8	28.1	24.7	48.3	0.0	0.0

Biomass in the Balsam

Number	Size	cm	each kg	each lb	total
75	2	5	4.285594	9.428307	707.1231
317	4	10	23.93243	52.65136	16690.48
27	6	15	65.45453	144	3887.999
3.1	8	20	133.6481	294.0258	911.4799
					22197.08

This stand had about 11 tons dry weight of total balsam (needles and all)- about half a cord of this is potential pulpwood (maybe)

Formula used is =EXP(-2.5384+2.4814*LN(G20))

Does it make sense?

- Reduces fire risk (ladder fuel)
- What percent would be harvestable?
- How much would this fuel treatment cost (\$300??)?
- Would this defer cost of fuel treatment

Conclusion

- Benefits well known
- Often leave the thinning “until it is commercial”
- Biomass pushes the window of a “commercial thinning” earlier
- Questions still remain as to economic potential

Goals

- Biomass basics
- Intro to soil impacts
- Intro to use for precommercial thinning
- **Intro to slash harvest**
- Intro to use for fire control

Where is this data from?

- USDA/DOE Joint Biomass Initiative
- I subcontracted this work to MnDNR Resource Assessment Team
- It is less than 2 years old

Woody Biomass Sources

- Logging Residue Largest potential source
- Other Sources of Woody Biomass:
 - Primary Mill Residue Much already utilized.
 - Secondary Mill Residue Much already utilized
 - Dedicated energy crops Modest volumes currently being grown.
 - Land clearing projects Powerlines, roads
 - Brush from brushlands Being examined
 - Precommercial thinning, TSI





BARIKO
150T

BARIKO

Peterson 4710

Peterson

QUIPPED





DO NOT ENTER
WOOD AREA UNTIL
LOADER FLASHES
BLUE LIGHT
& ACKNOWLEDGES



Logging Residue

Data from MNDNR

Class	ft3/ac	cds/ac
CWD	357	4.5
FWD	134	1.7
Standing residual	1476	6
Piles @ landing	50	0.6
Scattered piles	15	0.2

Goals

- Intro to use for precommercial thinning
- Intro to slash harvest
- Intro to use for fire control

12 test biomass harvests

- High-priority fuel reduction areas
- Low potential for commercial timber harvest
- Varied equipment and techniques used
- Pre- and post-harvest ecological and silvicultural data collection



Equipment

Valmet 3 wheel buncher



Equipment
JD 1490 D

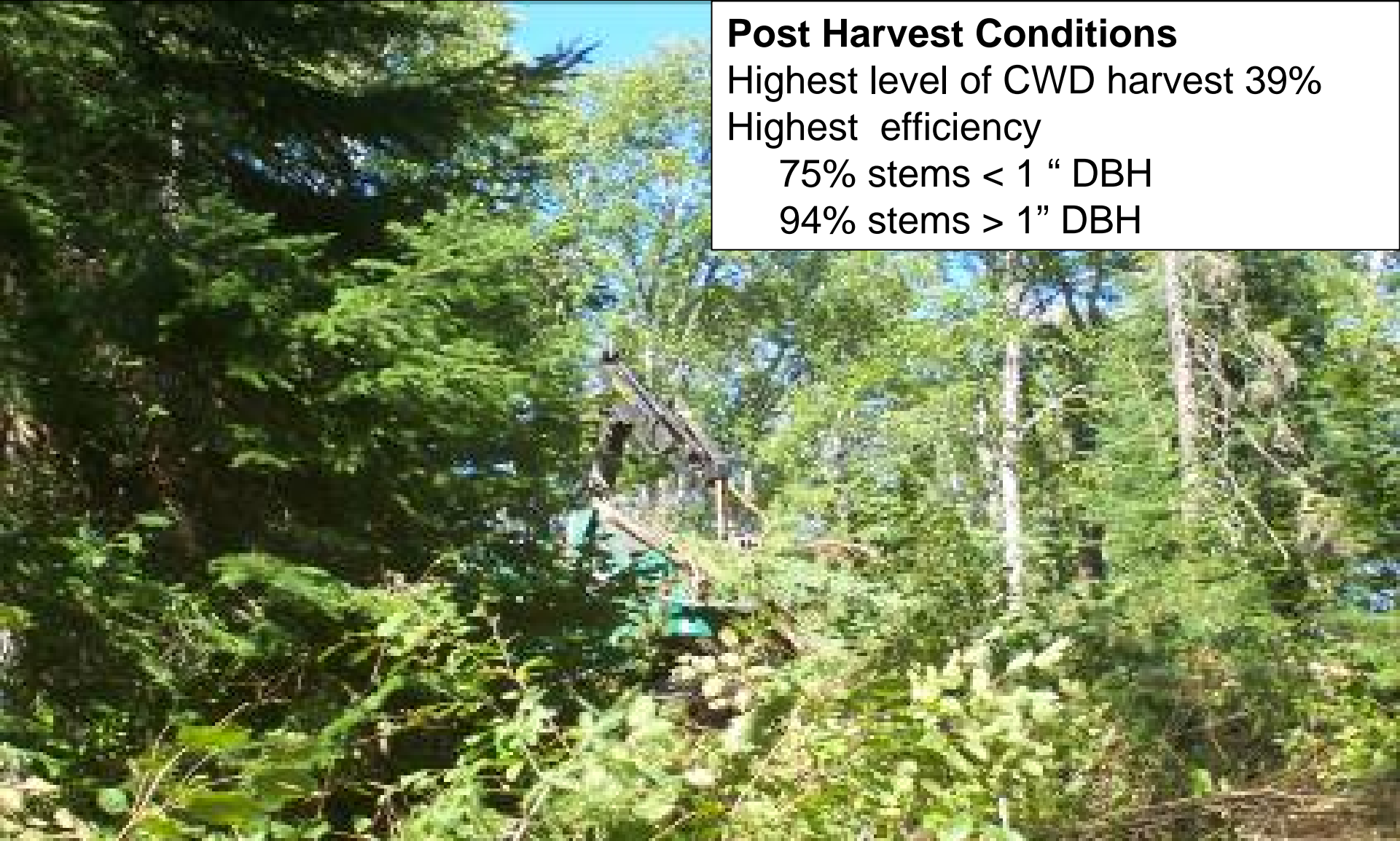


Equipment
Ponse Buffalo Dual w/ biomass head









Post Harvest Conditions

Highest level of CWD harvest 39%

Highest efficiency

75% stems < 1 " DBH

94% stems > 1" DBH





General Conclusions

- The highest CWD harvest was 39% removal.
- Even with a specific goal of removal of CWD, there were only low or moderate decreases and in one case an increases

General Conclusions

- Efficiencies at removal of submerchantable varied greatly.
- The highest efficiency 75% of the stems <1 inch DBH
- 94% of stems >1 inch DBH

Now a bunch of pictures











STAY BACK 70 FEET

14985





Next







Peterson

Peterson

4710

BARKO
160P



Peterson

Peterson 4710L



Next Site









AIR-RIDE EQUIPPED



Sold







175104 175104

STAY CLEAR
OF DUMPER
WHEN LIGHTS
FLASHING

Eric's



175104

175104

DO NOT ENTER
WOOD AREA UNTIL
LOADER FLASHES
BLUE LIGHT
ACKNOWLEDGE

Eddie



DO NOT ENTER
WOOD AREA UNTIL
LOADER FLASHES
BLUE LIGHT
& ACKNOWLEDGE





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BLUE LIGHT
ACKNOWLEDGE





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AND WRENCHES







Other Sources









Brush













