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Project Report No. 46, Loblolly Pine Plantations in East Texas Two Harvest Schedules No Thinning & Final Harvest at 25 Years Thin at 10 Years & Final Harvest at 25 Years Sawlog/Veneer Wood Flow Comparison, A Simulation

J. David Lenhart
Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University

Jennifer Allen
Stephen F. Austin State University

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...Two Harvest Schedules...
...No Thinning & Final Harvest at 25 years...
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...Sawlog/Veneer Wood Flow Comparison...
...A Simulation...

J. David Lenhart
Professor and ETPPRP Director
College of Forestry, SFASU, Nacogdoches, TX, 75962
and
Jennifer Allen
Student Assistant
College of Forestry, SFASU, Nacogdoches, TX, 75962

REPORT 46

THE SITUATION

In June, 1996, ETPPRP Report 45 presented the results of an investigation into the research question

=> Does a thinning increase total wood flow of East Texas loblolly pine plantations? <=

In the investigation, a comparison was made between
unthinned and thinned management regimes by simulating four possible thinning schedules

Thin at 10 years => Final harvest at 25 years
Thin at 15 years => Final harvest at 25 years
Thin at 15 years => Final harvest at 30 years
Thin at 20 years => Final harvest at 30 years

Results of the investigation indicated that in many situations

...........total wood flow was not increased by a thinning...........

Interesting results

And those results precipitated four additional research questions

Does a thinning increase the wood flow of trees that may be suitable for sawlog/veneer?
Does a thinning increase net present value of all products?
What is the role of economic parameters?
What is the effect of merchantability standards?

In an attempt to answer the new questions, a series of four new ETPPRP Reports have been developed

Report 46 ... thin at 10 / final harvest at 25
Report 47 ... thin at 15 / final harvest at 25
Report 48 ... thin at 15 / final harvest at 30
Report 49 ... thin at 20 / final harvest at 30

to compare a plantation management regime with no thinning
to
a plantation management regime with a thinning

This is Report 46 in the series of new investigations

TOPIC OF THIS REPORT

DOES A THINNING AT 10 YEARS WITH FINAL HARVEST AT 25 YEARS INCREASE SAWLOG/VENEER WOOD FLOW?
DOES A THINNING AT 10 YEARS WITH FINAL HARVEST AT 25 YEARS INCREASE NET PRESENT VALUE?

An illustration depicting the research questions...

For example, let us say there is a loblolly pine plantation in Polk county:

- 5 years old.
- Site index base age 25 years = 60'.
- 500 surviving trees per acre.
- Landowner plans a 25-year rotation age ... 20 more years until final harvest.

- During this 20-year period, landowner has two goals:
  - To maximize the production of trees with sawlog/veneer potential and
  - To maximize the net present value of all trees.

- To accomplish these goals, should the plantation remain unthinned until a final harvest 20 years hence?

- Or to accomplish these goals, should the plantation receive a thinning in 5 years, when it is 10 years old and a final harvest at age 25 years?

Recent work by
the East Texas Pine Plantation Research Project
may provide avenues to investigate the research question

....

Adams, D. E., J. D. Lenhart, A. B. Vaughn and J. Lapongan. 1996. Estimating survival of East Texas loblolly and slash pine plantations infected with fusiform rust. South. J. Appl. For. 20(1):30-35.

Lenhart, J. D. 1996. Total and partial stand-level yield prediction for loblolly and slash pine plantations in East Texas. South. J. Appl. For. 20(1):36-41.

A SIMULATION MODEL WAS CONSTRUCTED
TO REPRESENT THE SITUATION AND INVESTIGATE THE RESEARCH QUESTIONS

Model Components are:

Plantation Parameters

01. Species - loblolly pine.
02. Establish, grow and harvest one rotation.
03. Two possible plantation management schedules are considered.
    a. Final harvest at 25 years ... no thinning.
    b. Final harvest at 25 years ... thinning @ 10 years.
04. Items defined and set by user.
    a. Site index (base age 25 years).
    b. Surviving number of trees per acre @ 5 years.
    c. Percentage of trees with fusiform rust stem infection @ 5 years.
    d. Merchantability/Utilization standards.
        01) Minimum dbh value for pulpwood utilization.
        02) Minimum upper stem dob value for pulpwood utilization.
        03) Minimum dbh value for sawlog/veneer utilization.
        04) Minimum upper stem dob for sawlog/veneer utilization.
        05) Percentage of unthinned yield expected to be suitable for sawlog/veneer harvest.
        06) Percentage of residual yield expected to be suitable for sawlog/veneer harvest.
05. Unit of measure = tons per acre green weight of wood only.

Thinning Specifications

06. Timing of thinning is at plantation age = 10 years.
07. Percent of wood removed at 10 years of age. Four settings included in simulation model.
    a. 25%.   c. 50%.
    b. 33%.   d. 67%.
08. Increase in growth of residual trees between thinning and final harvest relative to unthinned growth during same period of time. Five settings included in simulation model.
    a. 0%.   c. 20%.   e. 40%.
    b. 10%.   d. 30%.

SIMULATION MODEL CONTINUED

Economic Values

09. Interest percent for alternative investments - compounded annually. For discounting future cash flows to 0 years hence.
10. Inflation percent - compounded annually. For compounding stumpage prices into the future.
11. Pulpwood stumpage price per ton at beginning of rotation (0 years hence).
12. Sawlog/veneer stumpage price per ton at beginning of rotation (0 years hence).
13. Establishment cost per acre (0 years hence).
14. Annual administration and operations cash flows each year for 25 years.

Mensurational Concepts

15. Future number of fusiform rust infected & uninfected trees per acre are estimated using the Adams et al. (1996) survival models.
16. For management schedule 3a above (no thinning), total yield (Q) at age 25 years (final harvest) is estimated using Lenhart (1996) prediction models.
17. For a management schedule with thinning at age 10 years, a thinning simulation was designed as:
    a. Using Lenhart (1996), total yield (R) is predicted at age 10 years.
    b. Using R & Q wood flow values as present value & future value, respectively, plus the number of years between thinning and final harvest as 15, a compound growth percentage (interest rate) can be calculated.
    c. In turn, this growth percentage is increased by the values listed in 8a - 8e above to represent hypothetical increases in growth of residual trees following a thinning.
    d. Thinning wood flow is determined by multiplying values listed in 7a - 7d above by the expected yield in year of thinning.
    e. By subtraction, a residual yield is calculated after each thinning.
    f. Using the modified growth %s from 17c above, residual yield is compounded year-by-year for a wood flow at final harvest 15 years later.
    g. All yields are computed after consideration of merchantability standards listed in 4d above.
    h. The percentage of unthinned yield expected to be available for sawlog/veneer utilization at 25 years can vary, see 4d above.
    i. The percentage of residual trees expected to be available for sawlog/veneer utilization at 25 years can vary, see 4d above.

CHARTS 1 - 9

- Results of the simulation runs are presented in 9 charts on the last 18 pages of this report.

- One chart for each plantation parameter combination.

- In turn, each chart consists of specified management parameters:
  - Three percentages of residual yield at final harvest expected to be sawlog/veneer merchantable.
  - Four percentages of possible yield removed at thinning.
  - Five percentages of possible increases in residual tree growth rate after thinning.

- Management information is presented in 60 pairs of ellipses.

- First ellipse in a pair is the difference of:
  (sawlog/veneer wood flow/acre with a thinning) -
  (sawlog/veneer wood flow/acre with no thinning).

- Second ellipse in a pair is the difference of:
  (npv/acre for all products with a thinning) -
  (npv/acre for all products with no thinning).

- Shaded ellipses depict management situations where a thinning at 10 years may be advantageous.
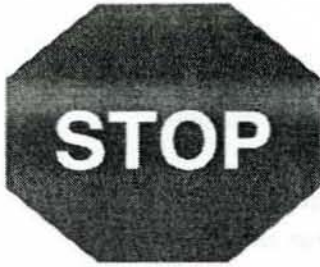
STOP   Rotation age = 25 years
Thin at 10 years?

Advantageous?   **STOP**

We recommend caution and care in interpreting and applying the results of the comparisons in Charts 1-9 because:

Advantages in sawlog/veneer wood flow are sensitive to age, site index, trees per acre and fusiform rust and merchantability standards.
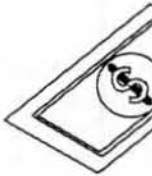
Advantages in net present value are also sensitive to items mentioned above. In addition, varying interest rates, inflation rates, stumpage prices, establishment costs and annual cash flows probably influence NPV, but this was not investigated in this report.

The 9 charts in this Report 46
provide general indications of possible trends in comparing no thin regimes to thinning regimes.

Due to high sensitivity,
it may be necessary to fine-tune plantation parameter and management factor combinations to specific values to meet particular situations.

However, we do want to alert readers that in some cases there may be management circumstances that override the results in the charts 1-9.

Several caveats about the comparisons...
- A wide-ranging comprehensive sensitivity analysis was not conducted.
- Data on actual response of East Texas loblolly pine plantations to these types of thinnings are not available.
- Genetic considerations are not included.
- Herbecide applications are not included.
- Pruning treatments are not included.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH
- SITE INDEX BASE AGE 25 YRS = 50'
- TREES PER ACRE @ 5 YRS = 300
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = $10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = $50

...One Possible Plantation Management Plan...
...Establish...
...Grow...
...Final harvest of pulpwood and sawlog/veneer at 25 yrs...
...This Plan with no thinning is expected to produce...
...8 tons/acre of sawlog/veneer timber...
...Net present value of all products is $220/acre...

...Another Possible Plantation Management Plan...
...Establish...
...Grow...
...Pulpwood thin at 10 yrs ...
...Grow residual...
...Final harvest of residual pulpwood and sawlog/veneer at 25 yrs...

Management question ... Is a thinning @ 10 years advantageous?

For each of the three following merchantability percentage values - 50%, 70% & 90%, there is a set of ellipse pairs.
Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates.
The first ellipse of a pair = { tons/acre with a thinning } - {8 tons/acre with no thinning} for sawlog/veneer only.
The second ellipse of a pair = { npv/acre with a thinning } - {$220/acre with no thinning} for all products.
Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	3	$16	1	-$8	-1	-$59	-3	-$110
10%	6	$85	4	$53	1	-$13	-2	-$80
20%	9	$172	8	$131	4	$45	0	-$41
30%	14	$282	12	$229	9	$118	2	$7
40%	20	$420	17	$353	11	$211	5	$68

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH
- SITE INDEX BASE AGE 25 YRS = 50'
- TREES PER ACRE @ 5 YRS = 700
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = $10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = $50

...One Possible Plantation Management Plan...
...Establish...
...Grow...
...Final harvest of pulpwood and sawlog/veneer at 25 yrs ...
...This Plan with no thinning is expected to produce...
...1 ton/acre of sawlog/veneer timber...
...Net present value of all products is $159/acre...

...Another Possible Plantation Management Plan...
...Establish...
...Grow...
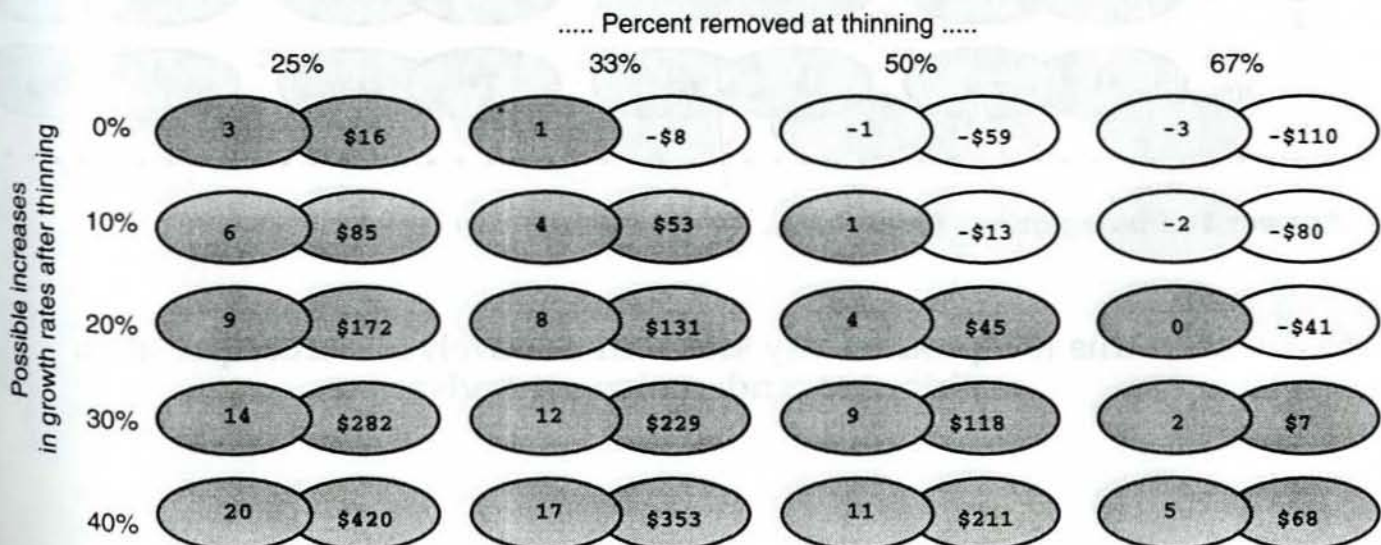*...Pulpwood thin at 10 yrs ...*
...Grow residual...
...Final harvest of residual pulpwood and sawlog/veneer at 25 yrs...

Management question ... Is a thinning @ 10 years advantageous?

For each of the three following merchantabiity percentage values- 50%, 70% & 90%, there is a set of ellipse pairs.
Each set has 20 combinations of percent of yield removed and possilbe increases in residual growth rates.
The first ellipse of a pair = { tons/acre with a thinning } - { 1 ton/acre with no thinning } for sawlog/veneer only.
The second ellipse of a pair = { npv/acre with a thinning } - { $159 npv/acre with no thinning } for all products.
Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning

	25%		33%		50%		67%	
0%	13	$159	11	$125	8	$54	5	-$17
10%	19	$303	17	$254	12	$150	8	$46
20%	28	$507	25	$436	18	$286	12	$136
30%	40	$792	36	$691	26	$476	17	$261
40%	58	$1,189	51	$1,046	38	$741	25	$436

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	18	$243	16	$201	12	$110	7	$20
10%	27	$426	24	$364	18	$232	11	$100
20%	39	$684	35	$594	26	$404	17	$214
30%	57	$1,045	51	$917	37	$645	24	$373
40%	81	$1,548	72	$1,367	54	$980	35	$594

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	24	$327	21	$276	15	$166	10	$57
10%	35	$549	31	$473	23	$314	15	$154
20%	51	$861	45	$753	34	$522	22	$292
30%	73	$1,299	65	$1,144	49	$814	32	$484
40%	105	$1,908	93	$1,687	69	$1,220	45	$752

Answers to Management Question...

On this low productivity site with relatively high trees per acre, a thinning appears to have a definite advantage.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH
- SITE INDEX BASE AGE 25 YRS = 70'
- TREES PER ACRE @ 5 YRS = 300
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = $10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = $50

> *...One Possible Plantation Management Plan...*
> *...Establish...*
> *...Grow...*
> *...Final harvest of pulpwood and sawlog/veneer at 25 yrs ...*
> *...This Plan with no thinning is expected to produce...*
> *...71 tons/acre of sawlog/veneer timber...*
> *...Net present value of all products is $1,441/acre...*

> *...Another Possible Plantation Management Plan...*
> *...Establish...*
> *...Grow...*
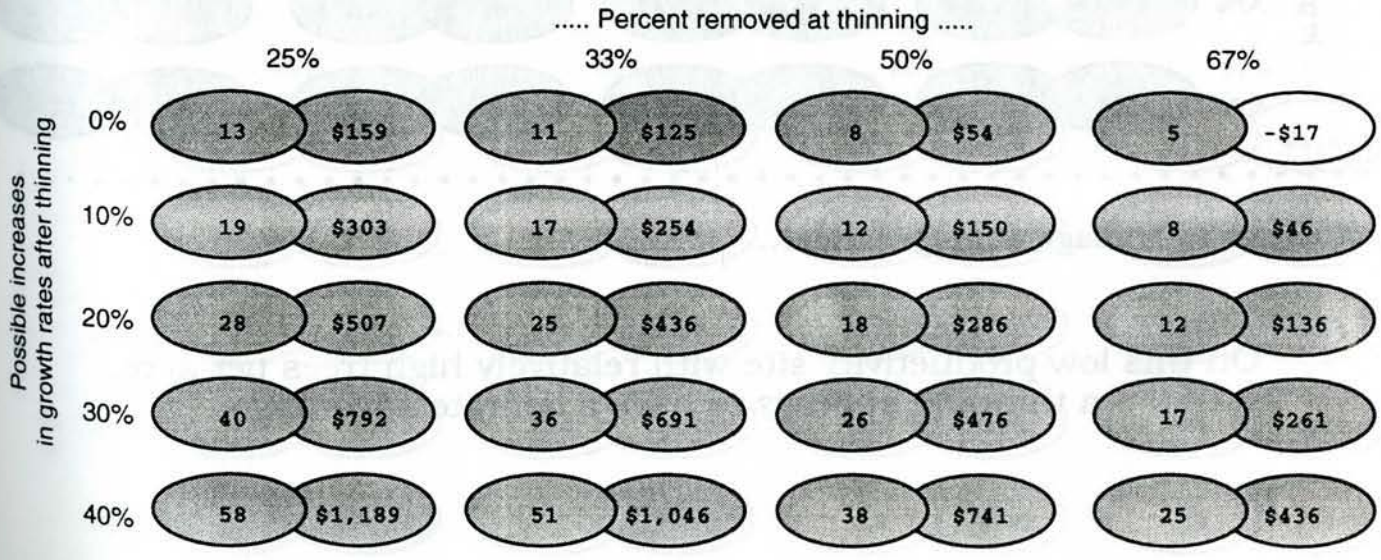> *...Pulpwood thin at 10 yrs ...*
> *...Grow residual...*
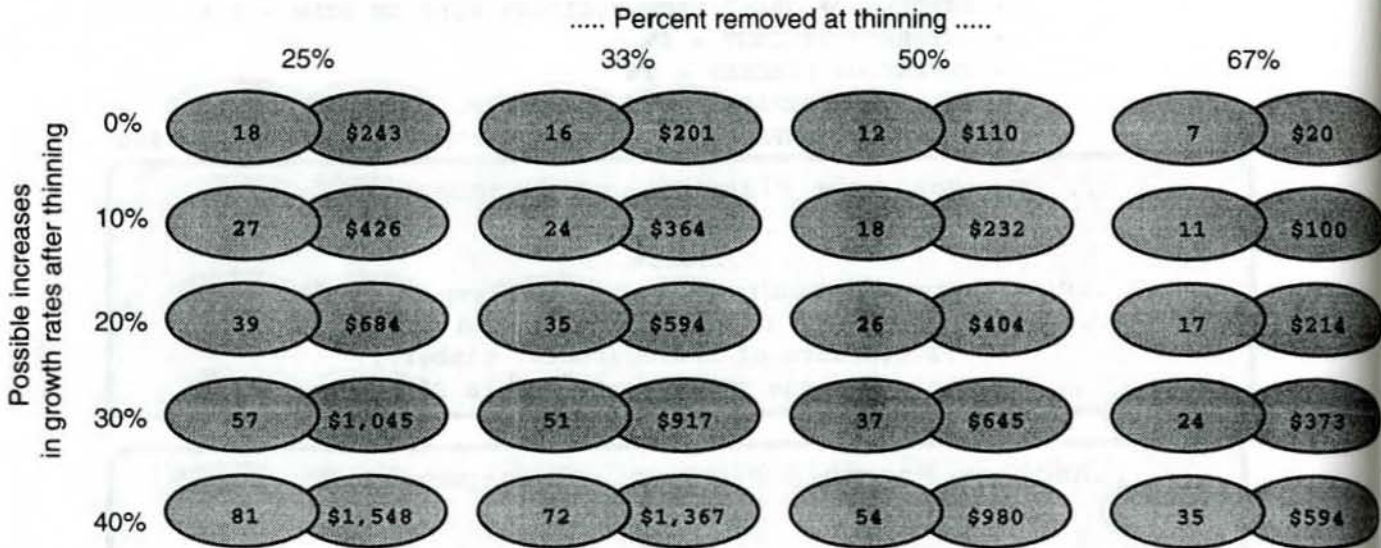> *...Final harvest of residual pulpwood and sawlog/veneer at 25 yrs...*

Management question ... Is a thinning @ 10 years advantageous?

For each of the three following merchantability percentage values- 50%,70% & 90%, there is a set of ellipse pairs.
Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates.
The first ellipse of a pair = { tons/acre with a thinning } - { 71 tons/acre with no thinning } for <u>sawlog/veneer only</u>.
The second ellipse of a pair = { npv/acre with a thinning } - { $1,441 npv/acre with no thinning } for <u>all products</u>.
Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.
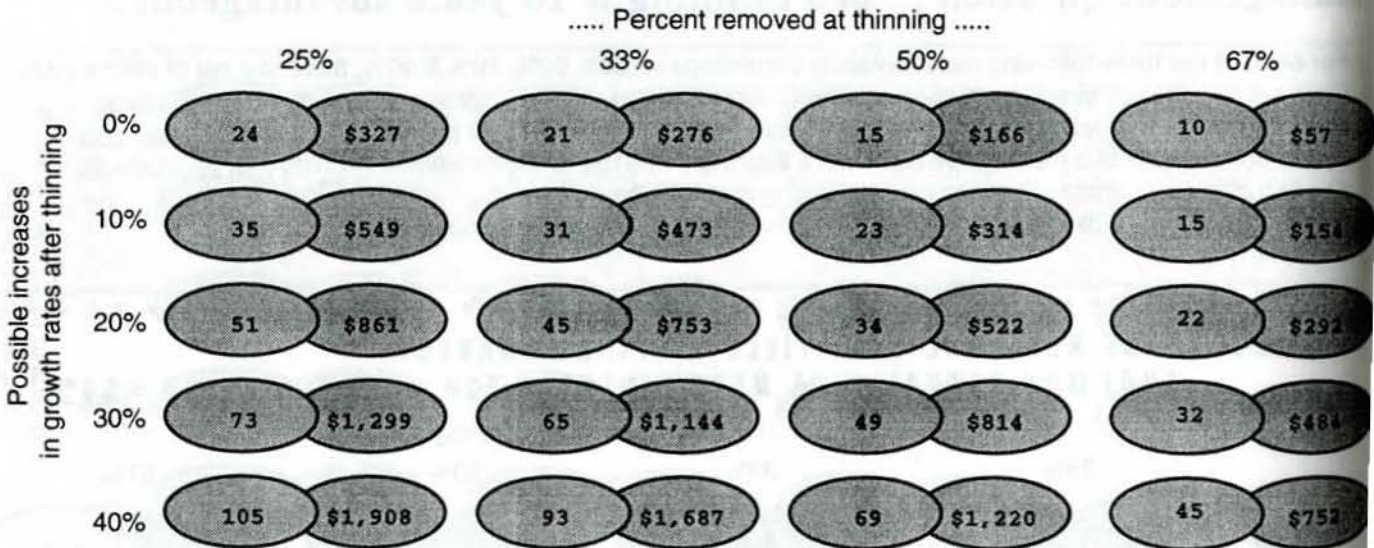
PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning

	25%		33%		50%		67%	
0%	-36	-$612	-39	-$691	-47	-$859	-55	-$1,027
10%	-28	-$447	-33	-$544	-43	-$750	-52	-$955
20%	-20	-$252	-25	-$370	-37	-$619	-48	-$869
30%	-10	-$20	-16	-$163	-30	-$465	-44	-$767
40%	2	$254	-6	$82	-22	-$282	-39	-$646

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = <u>70%</u>

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	−22	−$397	−27	−$499	−38	−$716	−49	−$933
10%	−11	−$188	−18	−$313	−31	−$577	−45	−$841
20%	0	$59	−7	−$92	−32	−$412	−39	−$732
30%	15	$353	5	$171	−14	−$216	−33	−$603
40%	31	$700	20	$481	−3	$15	−26	−$450

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = <u>90%</u>

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	−7	−$182	−14	−$307	−29	−$572	−43	−$838
10%	5	$71	−3	−$81	−20	−$404	−37	−$727
20%	21	$370	11	$186	−10	−$204	−30	−$595
30%	39	$725	27	$504	2	$32	−22	−$439
40%	60	$1,146	46	$879	17	$312	−13	−$254

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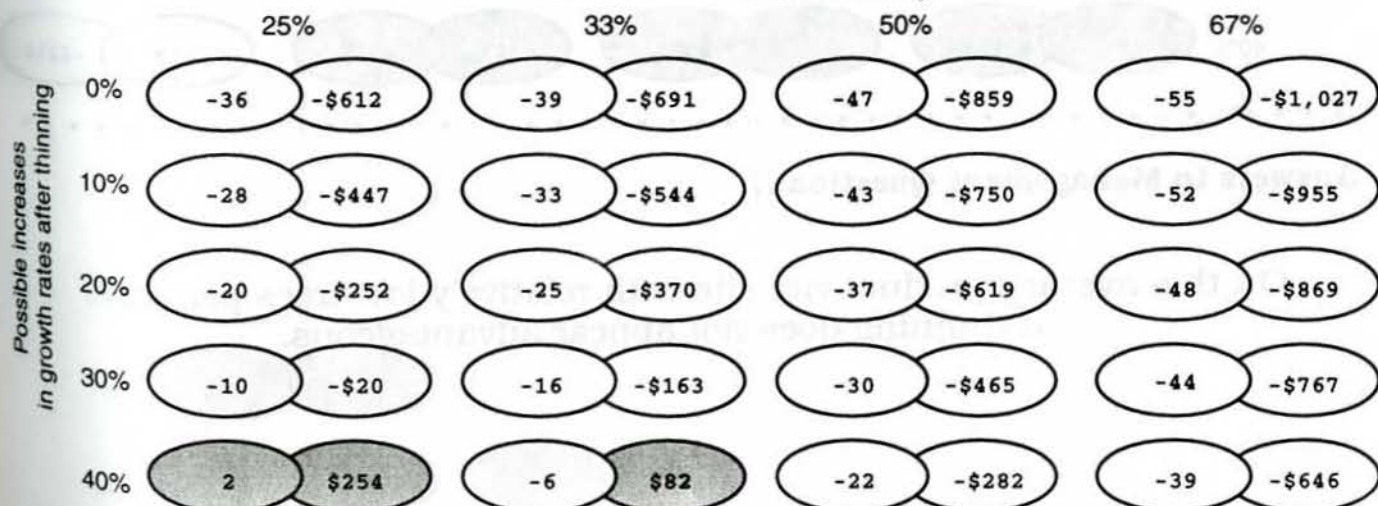
Answers to Management Question...

On this average productivity site with relatively low trees per acre, a thinning does not appear advantageous.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH
- SITE INDEX BASE AGE 25 YRS = 70'
- TREES PER ACRE @ 5 YRS = 500
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = $10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = $50

> ...One Possible Plantation Management Plan...
> ...Establish...
> ...Grow...
> ...Final harvest of pulpwood and sawlog/veneer at 25 yrs ...
> ...This Plan with no thinning is expected to produce...
> ...80 tons/acre of sawlog/veneer timber...
> ...Net present value of all products is $1,682/acre...

> ...Another Possible Plantation Management Plan...
> ...Establish...
> ...Grow...
> ...Pulpwood thin at 10 yrs ...
> ...Grow residual...
> ...Final harvest of residual pulpwood and sawlog/veneer at 25 yrs...

Management question ... Is a thinning @ 10 years advantageous?

For each of the three following mechantibilty percentage values- 50%, 70% & 90%, there is a set of ellipse pairs.
Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates.
The first ellipse of a pair = { tons/acre with a thinning } - { 80 tons/acre with no thinning } for sawlog/veneer only.
The second ellipse of a pair = { npv/acre with a thinning } - { $1,682 npv/acre with no thinning } for all products.
Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%
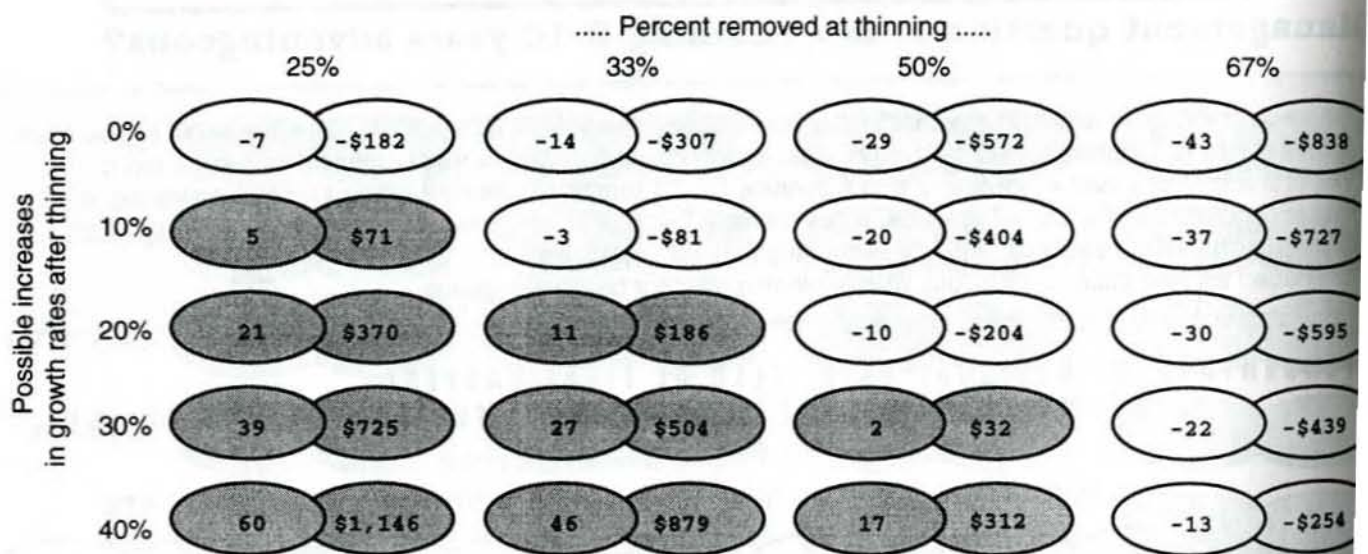
..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	-35	-$631	-40	-$732	-50	-$948	-60	-$1,165
10%	-26	-$408	-31	-$533	-44	-$800	-56	-$1,066
20%	-14	-$140	-21	-$294	-36	-$622	-51	-$949
30%	0	$180	-9	-$8	-27	-$408	-45	-$808
40%	17	$562	6	$333	-16	-$153	-38	-$640

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%

..... Percent removed at thinning .....

	25%	33%	50%	67%
0%	-17 / -$357	-24 / -$488	-38 / -$766	-53 / -$1,044
10%	-4 / -$75	-12 / -$236	-29 / -$578	-47 / -$920
20%	12 / $264	3 / $67	-18 / -$352	-39 / -$771
30%	32 / $669	20 / $429	-5 / -$82	-31 / -$593
40%	55 / $1,154	41 / $862	10 / $241	-21 / -$380

Possible increases in growth rates after thinning

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%

..... Percent removed at thinning .....

	25%	33%	50%	67%
0%	0 / -$83	-8 / -$243	-26 / -$583	-45 / -$924
10%	18 / $259	7 / $62	-15 / -$356	-37 / -$773
20%	39 / $669	26 / $428	-1 / -$82	-28 / -$593
30%	64 / $1,159	49 / $867	16 / $245	-17 / -$377
40%	94 / $1,745	75 / $1,390	36 / $636	-4 / -$119

Possible increases in growth rates after thinning

• •

Answers to Management Question...

On this average productivity site with typical trees per acre,
a thinning tends to not have an advantage.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH
- SITE INDEX BASE AGE 25 YRS = 70'
- TREES PER ACRE @ 5 YRS = 700
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = $10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = $50

> *...One Possible Plantation Management Plan...*
> *...Establish...*
> *...Grow...*
> *...Final harvest of pulpwood and sawlog/veneer at 25 yrs ...*
> *...This Plan with no thinning is expected to produce...*
> *...83 tons/acre of sawlog/veneer timber...*
> *...Net present value of all products is $1,795/acre...*

> *...Another Possible Plantation Management Plan...*
> *...Establish...*
> *...Grow...*
> *...Pulpwood thin at 10 yrs ...*
> *...Grow residual...*
> *...Final harvest of residual pulpwood and sawlog/veneer at 25 yrs...*

Management question ... Is a thinning @ 10 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs.
Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates.
The first ellipse of a pair = { tons/acre with a thinning } - { 83 tons/acre with no thinning } for <u>sawlog/veneer only</u>.
The second ellipse of a pair = { npv/acre with a thinning } - { $1,795 npv/acre with no thinning } for <u>all products</u>.
Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.

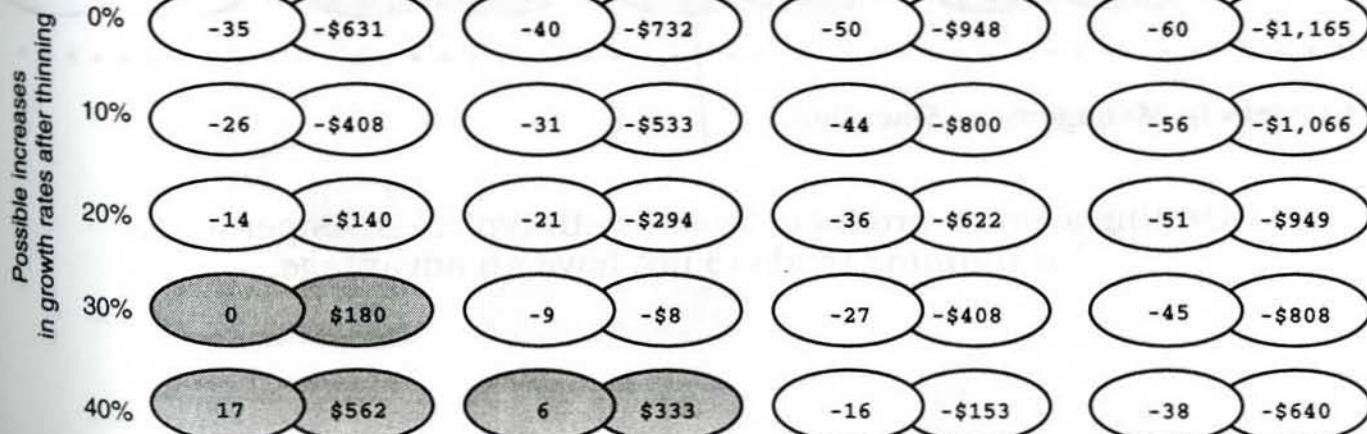## PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%
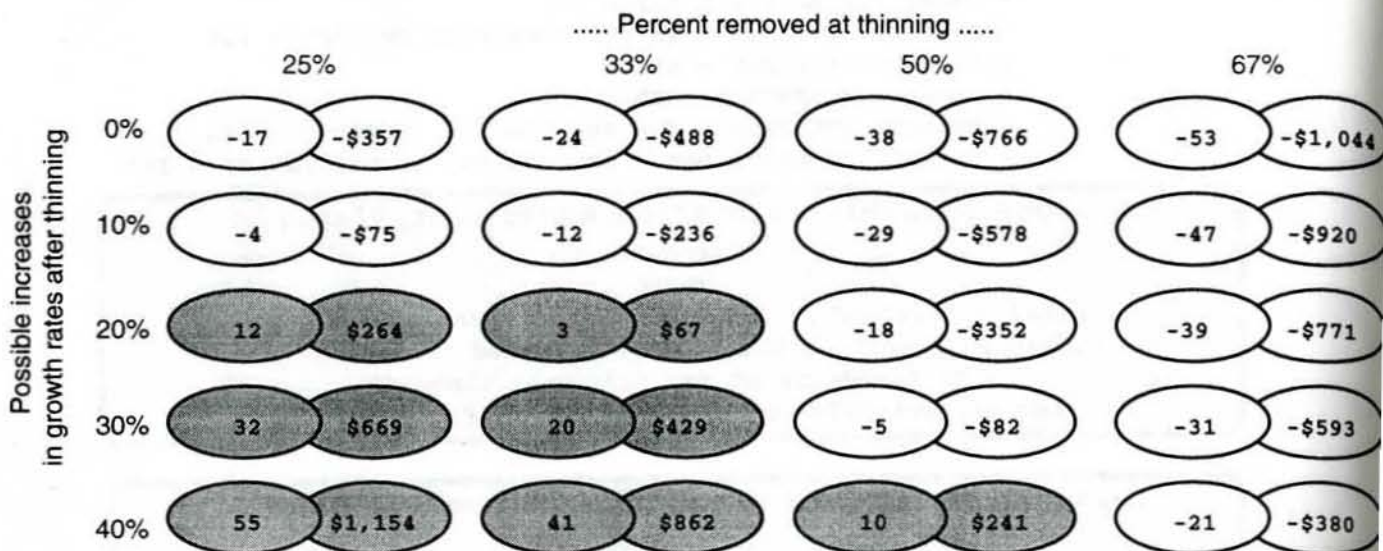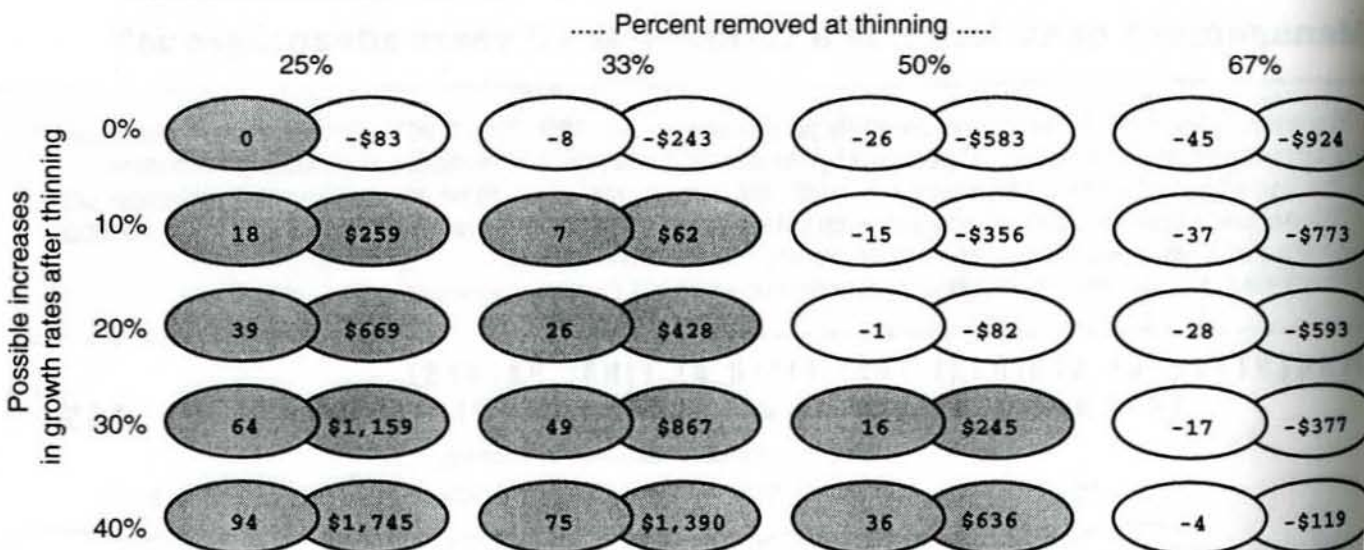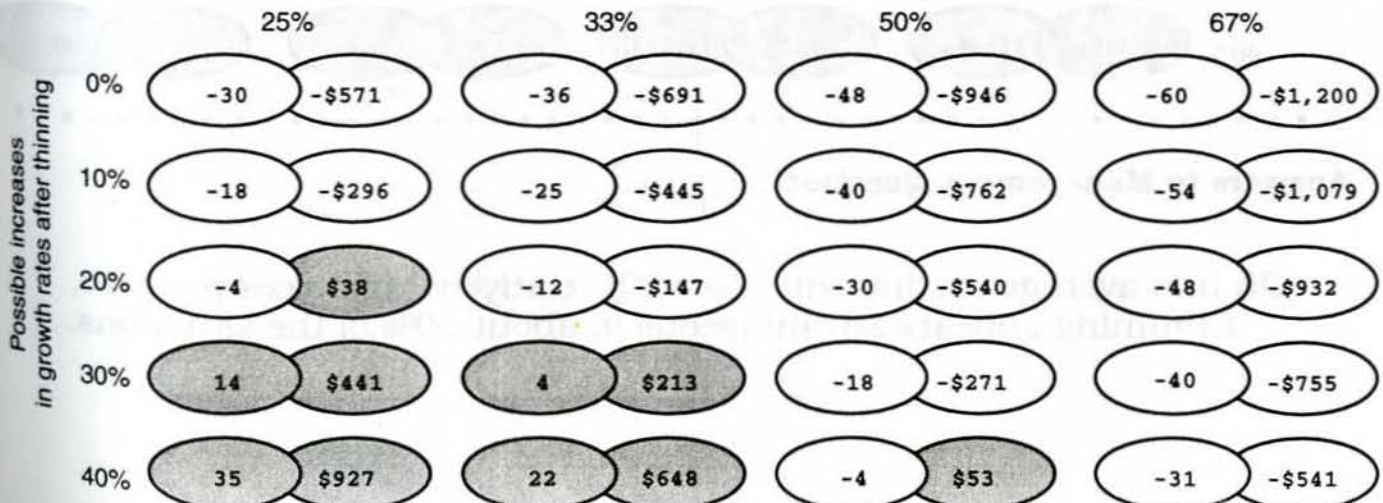
..... Percent removed at thinning .....

Possible increases in growth rates after thinning

	25%		33%		50%		67%	
0%	-30	-$571	-36	-$691	-48	-$946	-60	-$1,200
10%	-18	-$296	-25	-$445	-40	-$762	-54	-$1,079
20%	-4	$38	-12	-$147	-30	-$540	-48	-$932
30%	14	$441	4	$213	-18	-$271	-40	-$755
40%	35	$927	22	$648	-4	$53	-31	-$541

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	-9	-$252	-17	-$406	-34	-$733	-50	-$1,060
10%	7	$97	-2	-$94	-23	-$500	-43	-$906
20%	28	$520	16	$284	-9	-$218	-34	-$720
30%	52	$1,031	38	$740	7	$122	-23	-$495
40%	82	$1,646	65	$1,290	27	$533	-10	-$224

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	11	$68	1	-$120	-20	-$520	-41	-$919
10%	33	$490	21	$257	-5	-$238	-32	-$733
20%	59	$1,002	44	$714	12	$103	-20	-$508
30%	91	$1,620	72	$1,267	33	$515	-6	-$236
40%	129	$2,366	107	$1,933	59	$1,012	11	$92

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Answers to Management Question...

On this average productivity site with relatively high trees per acre, a thinning appears advantageous in about 50% of the situations.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH
- SITE INDEX BASE AGE 25 YRS = 90'
- TREES PER ACRE @ 5 YRS = 300
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = $10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = $50

> ...One Possible Plantation Management Plan...
> ...Establish...
> ...Grow...
> ...Final harvest of pulpwood and sawlog/veneer at _25 yrs_ ...
> ...This Plan with no thinning is expected to produce...
> ...190 tons/acre of sawlog/veneer timber...
> ...Net present value of all products is $3,763/acre...

> ...Another Possible Plantation Management Plan...
> ...Establish...
> ...Grow...
> ...Pulpwood thin at _10 yrs_ ...
> ...Grow residual...
> ...Final harvest of residual pulpwood and sawlog/veneer at _25 yrs_...

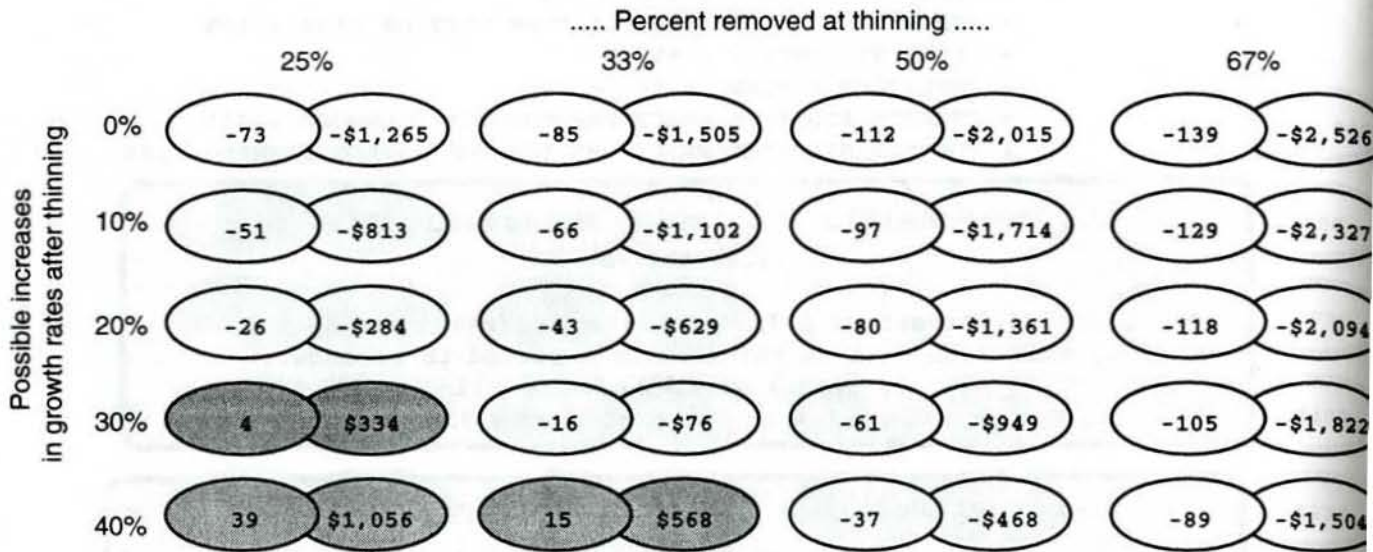## Management question ... Is a thinning @ 10 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs.
Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates.
The first ellipse of a pair = { tons/acre with a thinning } - {190 tons/acre with no thinning } for <u>sawlog/veneer only</u>.
The second ellipse of a pair = { npv/acre with a thinning } - { $3,763 npv/acre with no thinning } for <u>all products</u>.
Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = <u>50%</u>

..... Percent removed at thinning .....

	25%		33%		50%		67%	
0%	-106	-$1,778	-115	-$1,963	-134	-$2,357	-153	-$2,751
10%	-91	-$1,421	-101	-$1,645	-124	-$2,120	-146	-$2,594
20%	-73	-$1,004	-85	-$1,272	-112	-$1,841	-138	-$2,410
30%	-51	-$515	-66	-$835	-98	-$1,516	-129	-$2,196
40%	-26	$54	-44	-$326	-81	-$1,136	-118	-$1,945

Possible increases in growth rates after thinning

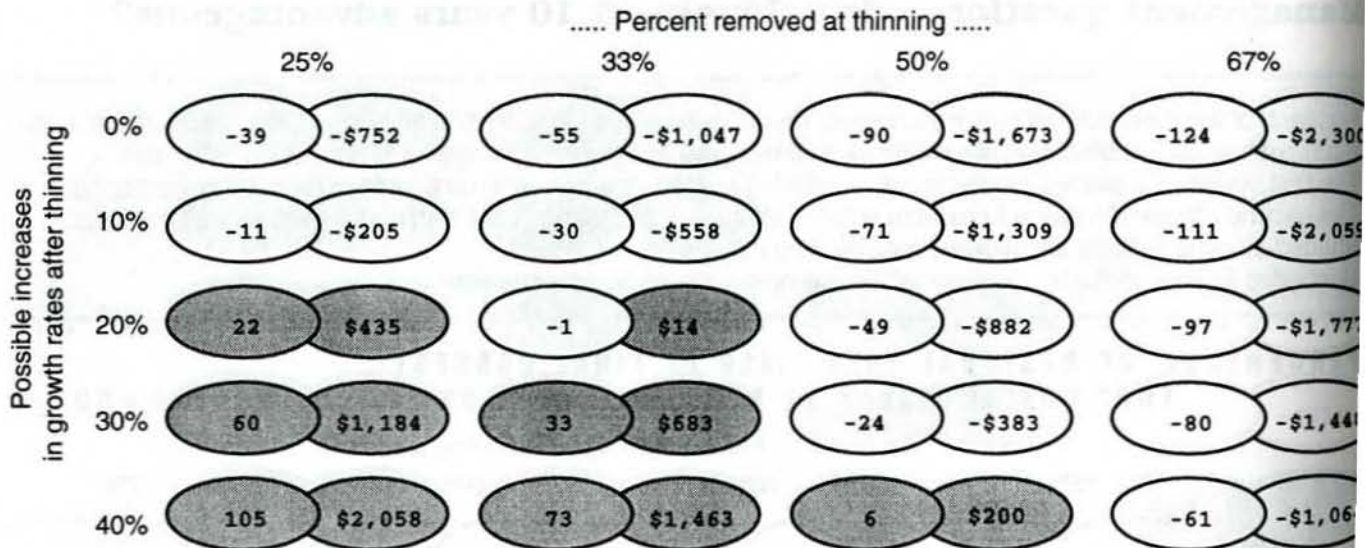## PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	-73	-$1,265	-85	-$1,505	-112	-$2,015	-139	-$2,526
10%	-51	-$813	-66	-$1,102	-97	-$1,714	-129	-$2,327
20%	-26	-$284	-43	-$629	-80	-$1,361	-118	-$2,094
30%	4	$334	-16	-$76	-61	-$949	-105	-$1,822
40%	39	$1,056	15	$568	-37	-$468	-89	-$1,504

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	-39	-$752	-55	-$1,047	-90	-$1,673	-124	-$2,300
10%	-11	-$205	-30	-$558	-71	-$1,309	-111	-$2,055
20%	22	$435	-1	$14	-49	-$882	-97	-$1,777
30%	60	$1,184	33	$683	-24	-$383	-80	-$1,444
40%	105	$2,058	73	$1,463	6	$200	-61	-$1,064

Answers to Management Question...

On this high productivity site with relatively low trees per acre, a thinning is generally not advantageous.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH
- SITE INDEX BASE AGE 25 YRS = 90'
- TREES PER ACRE @ 5 YRS = 500
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = $10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = $50

...One Possible Plantation Management Plan...
...Establish...
...Grow...
...Final harvest of pulpwood and sawlog/veneer at *25 yrs* ...
...This Plan with no thinning is expected to produce...
...238 tons/acre of sawlog/veneer timber...
...Net present value of all products is $4,734/acre...

...Another Possilbe Plantation Management Plan...
...Establish...
...Grow...
...Pulpwood thin at *10 yrs* ...
...Grow residual...
...Final harvest of residual pulpwood and sawlog/veneer at *25 yrs*...

Management question ... Is a thinning @ 10 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs.
Each set has 20 combinations of ercent of yield removed and possible increases in residual growth rates.
The first ellipse of a pair = { tons/acre with a thinning } - {238 tons/acre with no thinning } for sawlog/veneer only.
The second ellipse of a pair = { npv/acre with a thinning } - {$4,734 npv/acre with no thinning } for all products.
Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	-130	-$2,184	-141	-$2,423	-166	-$2,932	-190	-$3,441
10%	-109	-$1,714	-123	-$2,003	-152	-$2,619	-181	-$2,235
20%	-85	-$1,161	-101	-$1,510	-136	-$2,251	-171	-$2,991
30%	-56	-$513	-76	-$931	-117	-$1,818	-158	-$2,706
40%	-24	$246	-47	-$253	-95	-$1,312	-144	-$2,372

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%
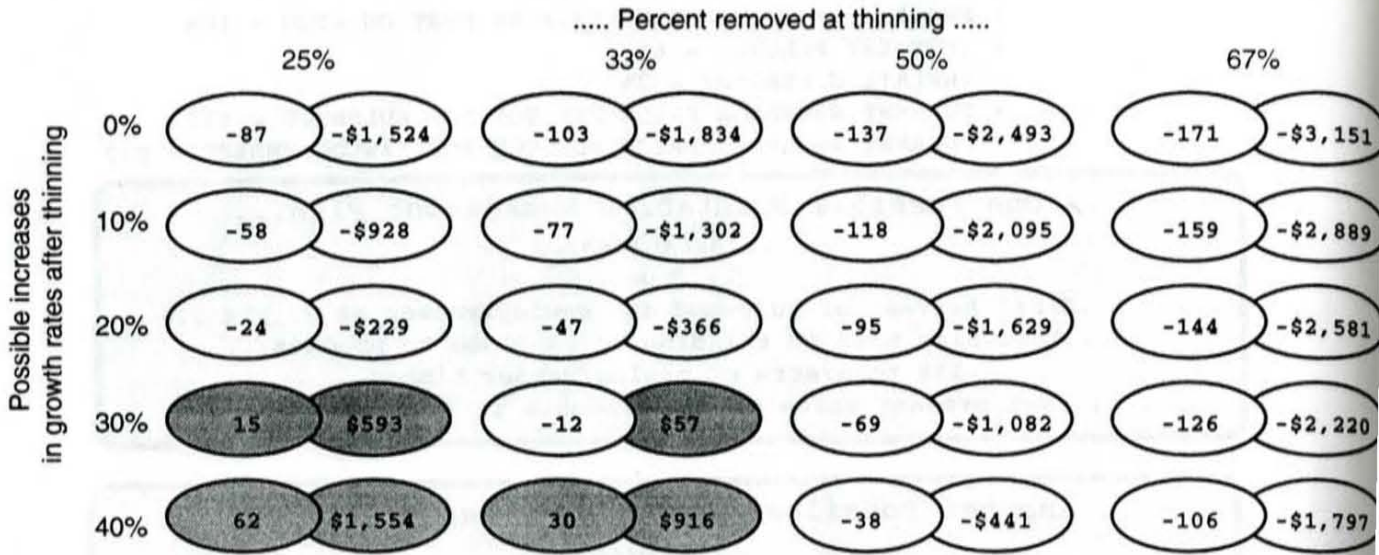
..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	-87	-$1,524	-103	-$1,834	-137	-$2,493	-171	-$3,151
10%	-58	-$928	-77	-$1,302	-118	-$2,095	-159	-$2,889
20%	-24	-$229	-47	-$366	-95	-$1,629	-144	-$2,581
30%	15	$593	-12	$57	-69	-$1,082	-126	-$2,220
40%	62	$1,554	30	$916	-38	-$441	-106	-$1,797

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%
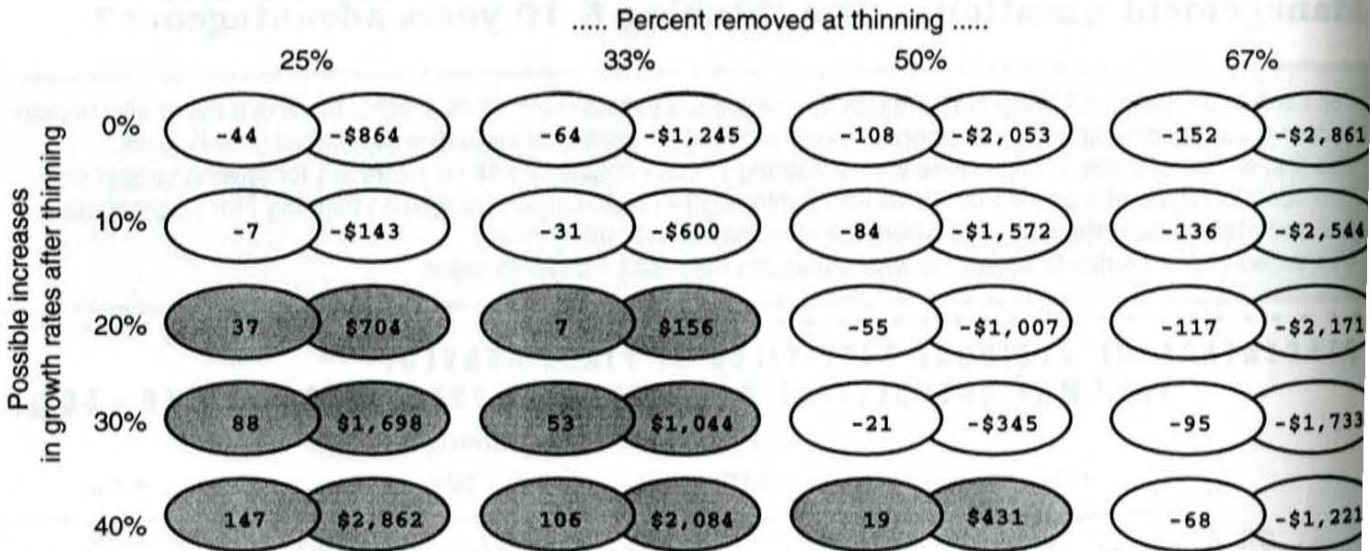
..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	-44	-$864	-64	-$1,245	-108	-$2,053	-152	-$2,861
10%	-7	-$143	-31	-$600	-84	-$1,572	-136	-$2,544
20%	37	$704	7	$156	-55	-$1,007	-117	-$2,171
30%	88	$1,698	53	$1,044	-21	-$345	-95	-$1,733
40%	147	$2,862	106	$2,084	19	$431	-68	-$1,221

Answers to Management Question...

On this high productivity site with typical trees per acre, a thinning tends to have no advantage.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH
- SITE INDEX BASE AGE 25 YRS = 90'
- TREES PER ACRE @ 5 YRS = 700
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = $10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = $50

...One Possible Plantation Management Plan...
...Establish...
...Grow...
...Final harvest of pulpwood and sawlog/veneer at _25 yrs_ ...
...This Plan with no thinning is expected to produce ...
...272 tons/acre of sawlog/veneer timber...
...Net present value of all products is $5,458/acre...

...Another Possible Plantation Management Plan...
...Establish...
...Grow...
...Pulpwood thin at _10 yrs_ ...
...Grow residual...
...Final harvest of residual pulpwood and sawlog/veneer at _25 yrs_...

Management question ... Is a thinning @ 10 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs.
Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates.
The first ellipse of a pair = { tons/acre with a thinning } - {272 tons/acre with no thinning } for sawlog/veneer only.
The second ellipse of a pair = { npv/acre with a thinning } - { $5,458 npv/acre with no thinning } for all products.
Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.

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PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

..... Percent removed at thinning .....

Possible increases in growth rates after thinning	25%		33%		50%		67%	
0%	-145	-$2,456	-159	-$2,739	-187	-$3,341	-216	-$3,944
10%	-120	-$1,889	-137	-$2,233	-171	-$2,964	-205	-$3,695
20%	-91	-$1,222	-111	-$1,637	-152	-$2,519	-193	-$3,341
30%	-57	-$436	-80	-$935	-129	-$1,995	-177	-$3,055
40%	-17	$487	-44	-$110	-102	-$1,380	-160	-$2,649

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%

..... Percent removed at thinning .....

	25%		33%		50%		67%	
0%	-94	-$1,678	-113	-$2,045	-154	-$2,823	-194	-$3,602
10%	-60	-$961	-82	-$1,404	-130	-$2,345	-179	-$3,286
20%	-19	-$115	-46	-$648	-103	-$1,781	-161	-$2,914
30%	29	$880	-3	$241	-71	-$1,118	-140	-$2,476
40%	85	$2,049	47	$1,285	-34	-$338	-115	-$1,962

(left axis: Possible increases in growth rates after thinning)

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%

..... Percent removed at thinning .....

	25%		33%		50%		67%	
0%	-43	-$901	-68	-$1,350	-120	-$2,305	-171	-$3,259
10%	1	-$32	-28	-$574	-90	-$1,726	-152	-$2,877
20%	53	$992	19	$340	-55	-$1,043	-129	-$2,427
30%	115	$2,196	74	$1,417	-14	-$240	-102	-$1,897
40%	188	$3,611	139	$2,681	34	$703	-70	-$1,274

(left axis: Possible increases in growth rates after thinning)

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Answers to Management Question...

On this high productivity site with relatively high trees per acre,
a thinning has an advantage in only a few situations.