V.2 Timber Supply Analysis Report

TREE FARM LICENCE 41
MANAGEMENT PLAN 6

TFL 41 TIMBER SUPPLY ANALYSIS

August 1999

Prepared for

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INTRODUCTION

The total landbase of Tree Farm Licence (TFL) 41 is 703,745 hectares. Of this total, 332,924 hectares (47.3%) is productive forest land. Not all the areas of productive forest are included in the timber harvesting landbase. In fact, 79% of the productive forest on TFL 41 is withdrawn from harvesting.

MANAGEMENT ZONES

Five management zones have been identified on TFL 41. These are general and enhanced timber production, and visual and riparian zones. In addition, the Wathl community watershed has been identified as a separate zone.

LANDBASE

In this report, harvest forecasts were made for three landbases. These were:

- the gross productive landbase,
- the planned management timber harvesting landbase,
- the conventional timber harvesting landbase.

The gross productive landbase contains all productive forest areas less deductions for existing and future roads. The planned management landbase represents the timber harvesting landbase defined by Skeena Sawmills. This landbase includes significant deductions from the gross productive landbase. After the deductions, only 21% of the productive forest remains in the timber harvesting landbase. The planned management landbase is defined in table 1. The conventional landbase contains only those areas of the planned management landbase that can be logged using conventional methods.

Table 1: Determination of the Planned Management Landbase

Description	Area Schedule A	Area Schedule B	Total Area	Volume Schedule A	Volume Schedule B	Total Volume
Total Landbase	906	702,838	703,745	214,583	98,080,745	98,295,328
Non-Forest	0	333,833	333,833	0	1,402,262	1,402,262
Non-Productive Forest	0	36,988	36,988	0	2,377,942	2,377,942
Total Productive Forest	906	332,018	332,924	214,583	94,300,541	94,515,124
Less:						
Inoperable/Inaccessible	66	240,170	240,236	22,704	59,440,423	59,463,126
NC (Non Commercial)	0	236	236	0	0	0
Low Site	0	68	68	0	7,449	7,449
Deciduous	2	2,824	2,826	41	533,528	533,569
Non-merchantable	3	1,176	1,178	901	311,020	311,922
ESAs	35	11,346	11,381	6,503	5,006,878	5,013,381
Riparian Reserves	23	4,128	4,151	6,230	1,949,041	1,955,271
Specific Geographically Defined Area	0	13	13	0	4,554	4,554
Unclassified Roads, trails and Landings	24	1,258	1,281	7	8,327	8,334
NSR	32	1,568	1,600	0	11	11
Wildlife Tree Patch	33	1,834	1,867	8,555	468,665	477,220
Total Current Reduction	218	264,619	264,837	44,940	67,729,896	67,774,836
Initial Timber Harvesting Landbase	688	67,398	68,086	169,643	26,570,645	26,740,288
Additions:						
NSR	32	1,568	1,600	0	0	0
Total Additions	32	1,568	1,600	0	0	0
Current Timber Harvesting Landbase	721	68,966	69,686	169,643	26,570,645	26,740,288
Future Reductions:						
Future roads, trails, landings	22	3,011	3,033	0	0	0
Future Timber Harvesting Landbase	699	65,954	66,653	169,643	26,570,645	26,740,288

*Numbers may not add up exactly due to rounding

The areas currently available for timber harvesting in each landbase are shown in table 2.

Table 2: Landbases

Gross Productive	281.421 ha
Planned Management	69,686 ha
Conventional Logging	64,525 ha

TIMBER SUPPLY ANALYSES

Four benchmarks were used in the timber supply analysis. These are shown in table 3.

Table 3: Benchmark Analyses

Name	Landbase	Cover Constraint	Roads, Trails and Landings	Old Growth Site Index Conversions
Potential	gross productive	same as planned management	6% of areas older than 35 years	for all species where MoF conversions are available
Planned Management	planned management	planned management	6% of areas older than 35 years	for all species where MoF conversions are available
Conventional	conventional	planned management	6% of areas older than 35 years	for all species where MoF conversions are available
Constrained Conventional	conventional	planned management	8% of areas older than 35 years	only for western hemlock

Including the four benchmarks of table 3, a total of 108 computer harvest schedules were run. Of these, 55 were even flow harvest forecasts and 53 were stepdown harvest forecasts.

In TFL 41, the approved 20-year plan demonstrates that the present AAC of 400,000 cubic metres can be maintained for the next 24 years. The timber supply analysis confirms this by finding 400,000 cubic metres for the next 30 years in the planned management benchmark run. In the long run, starting 90 years from now, the planned management benchmark forecasts future even flow harvests of 510,000 cubic metres per year. This is a 27% increase over today's harvest. Starting 30 years from now, the planned management benchmark forecasts reduced harvests for a 60-year period.

The sensitivity analyses for both even flow and stepdown harvest forecasts show that (after OGSI adjustments) results are most sensitive to changes in the landbase and to the rotation ages. When minimum harvest ages are reduced by ten years, there is a significant increasein the mid term timber supplies. When the planned management landbase is increased by 10% and the minimum harvest ages are reduced by ten years, no reduction in harvests occurs between years 30 to 90.

BENCHMARK HARVEST FORECASTS

Harvest forecasts were made for the four benchmarks shown in table 3. Stepdown harvest schedules were calculated for the planned management, conventional and constrained conventional benchmarks.

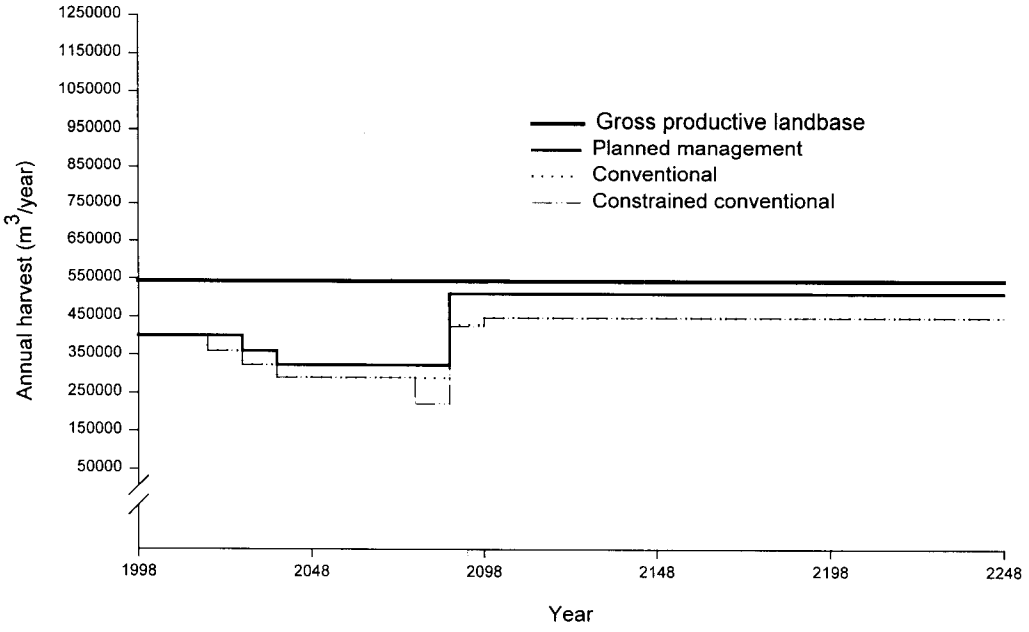
The table below shows the results of the four benchmark runs.

Figure 1 shows three benchmark stepdown harvest forecasts and one even flow benchmark.

Table 4: TFL 41 Benchmark Runs

Decade	Potential	A Planned	B Conventional	Constrained Conventional
1	543,475	400,000	400,000	400,000
2	543,475	400,000	400,000	400,000
3	543,475	400,000	359,800	359,800
4	543,475	359,800	323,620	323,620
5	543,475	323,620	291,058	291,058
6	543,475	323,620	291,058	291,058
7	543,475	323,620	291,058	291,058
8	543,475	323,620	291,058	291,058
9	543,475	323,620	289,513	222,112
10	543,475	510,500	428,969	424,812
11	543,475	510,500	448,000	448,000
12-25	543,475	510,500	448,000	448,000

Figure 1: Benchmark Harvest Forecasts



Sensitivity Analyses

Sensitivity analyses for the stepdown benchmarks were made by varying different assumptions. Sensitivity analyses showed that the most important assumptions affecting future harvests were:

- old growth site index conversions,
- landbase assumptions,
- minimum harvest ages.

Figures 2 - 4 show these sensitivity runs compared with each benchmark run.

Old growth site index (OGSI) conversions were made to old growth hemlock leading, balsam leading and cedar leading forest stands in all benchmark runs except for the constrained conventional. Here, adjustments were made only to all hemlock leading stands. In the sensitivity runs the label 'OGSI in WH only' means that only hemlock leading stands were adjusted.

Figure 2: Planned Management Sensitivity Analyses

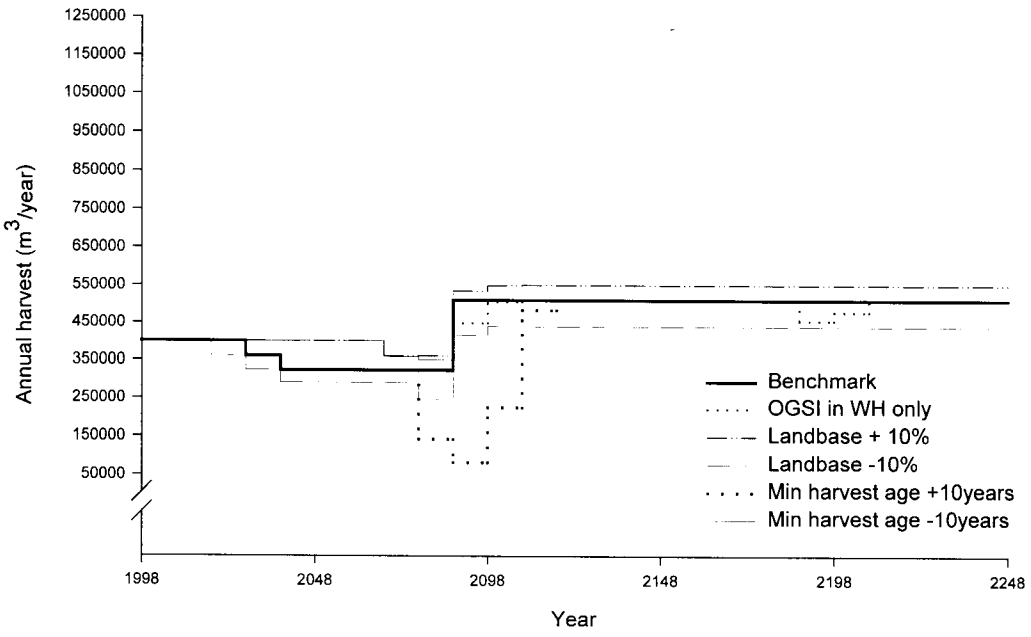


Figure 3: Conventional Sensitivity Analyses

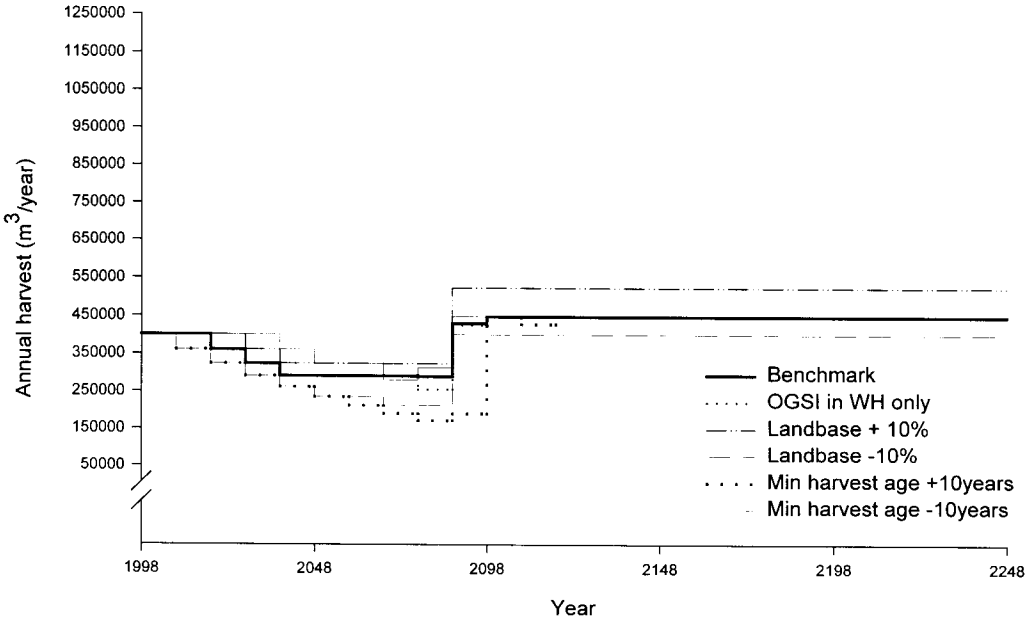
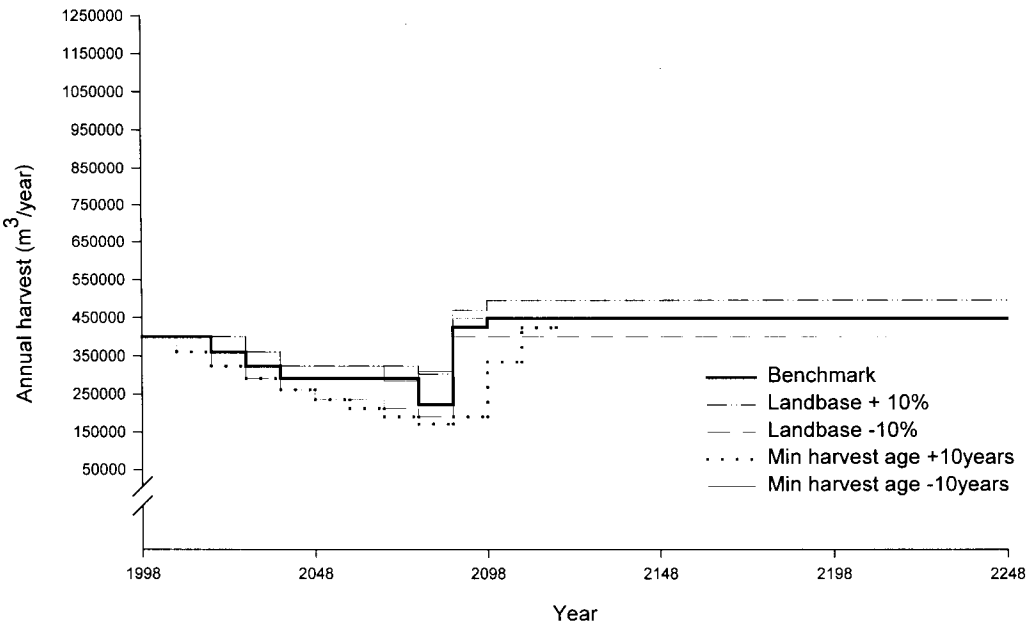


Figure 4: Constrained Conventional Sensitivity Analyses



Of particular interest in the sensitivity analyses is the improvement to mid-term timber supplies caused by reducing the minimum harvest age by ten years. A similar effect results from increasing the net landbase by 10%. Table 5 below shows the harvest schedules. An additional run, where minimum harvest ages were reduced by ten years **and** the landbase increased by 10%, was also completed. Tables 5 and 6 show these results compared with the planned management and constrained conventional benchmarks respectively.

Table 5: Planned Management
Solving the Mid-term Wood Supply Problem

Decade	Base	A Harv age -10	B Land +10%	A + B
1	400,000	400,000	400,000	400,000
2	400,000	400,000	400,000	400,000
3	400,000	400,000	400,000	400,000
4	359,800	400,000	400,000	400,000
5	323,620	400,000	400,000	400,000
6	323,620	400,000	400,000	400,000
7	323,620	400,000	400,000	400,000
8	323,620	357,893	359,800	400,000
9	323,620	350,198	359,800	550,200
10	510,500	510,500	534,754	550,200
11	510,500	510,500	550,096	550,200
12-25	510,500	510,500	550,200	550,200

Table 6: Constrained Conventional
Solving the Mid-term Wood Supply Problem

Decade	Base	A Harv age -10	B Land +10%	A + B
1	400,000	400,000	400,000	400,000
2	400,000	400,000	400,000	400,000
3	359,800	400,000	400,000	400,000
4	323,620	359,800	359,800	400,000
5	291,058	323,620	323,620	400,000
6	291,058	323,620	323,620	359,800
7	291,058	323,620	323,620	359,800
8	291,058	284,654	323,620	359,800
9	222,112	310,237	302,711	359,800
10	424,812	448,000	469,079	359,800
11	448,000	448,000	495,100	495,100
12-25	448,000	448,000	495,100	495,100

CONCLUSIONS

The planned management timber harvesting landbase is only 21% of the gross productive landbase. The biological potential even flow harvest from the gross productive landbase is 1.1 million cubic metres per year. The approved 20-year plan using current green-up and adjacency rules indicates about 24 years of harvest at the present allowable rate of 400,000 cubic metres per year. This agrees with the results of the timber supply analysis which shows 30 years of current harvest to be available in the planned management benchmark run.

On TFL 41, timber supplies are expected to be plentiful in the next 20 years and in the long term. Timber supplies are forecasted to be tight in the medium term. The sensitivity analyses shows that medium term timber supplies can be increased significantly by shortening the minimum harvest age by ten years. Additional analysis shows that medium term harvest rates can be maintained at 400,000 cubic metres per year when the minimum harvest age is shortened by ten years and, at the same time, the timber harvesting landbase is increased by 10% (6,800 hectares).

It is recommended that the harvest rate for the next five years from TFL 41 be maintained at 400,000 cubic metres per year.

INTRODUCTION

This report describes the timber supply analysis for TFL 41, which is part of the new management plan 6.

There are four main sections in this report:

1. Landbase assumptions
2. Yield assumptions
3. Harvesting assumptions
4. Results.

LANDBASE ASSUMPTIONS

The landbase information came from both timber and non-timber inventories completed by West Fraser Mills Ltd. between 1995-1998. Skeena Sawmills Division, West Fraser Mills Ltd. provided all digital inventory databases to Sterling Wood Group which we used to forecast a rate of timber harvest.

The 69,686 hectares (including NSR) in table 1 represent the current timber harvesting landbase. Table 1 shows how this landbase was determined.

In TFL 41, the total land area is 703,745 hectares. Of this area, 332,924 hectares (47.3%) is productive forest land. Not all the areas of productive forest land are included in the timber harvesting landbase. For example, riparian buffers are withdrawn from harvesting. In total, 79% of the total productive forest on TFL 41 is withdrawn from harvesting and 6% of the current timber harvesting landbase older than 35 years (to be used for future roads) must be removed from the future timber harvesting landbase.

Five management zones have been identified on TFL 41. These are general, enhanced timber production, visual, riparian and the Wathl community watershed.

Table 2 shows the area summary for the overlapped management zones. The NSR, 1,600 ha was not included in table 2. The detailed area summary was presented in the data package, in table 17.

Table 1: Operable Landbase Determination for Planned Management

Description	Area Schedule A	Area Schedule B	Total Area	Volume Schedule A	Volume Schedule B	Total Volume
Total Landbase	906	702,838	703,745	214,583	98,080,745	98,295,328
Non-Forest	0	333,833	333,833	0	1,402,262	1,402,262
Non-Productive Forest	0	36,988	36,988	0	2,377,942	2,377,942
Total Productive Forest	906	332,018	332,924	214,583	94,300,541	94,515,124
Less:						
Inoperable/Inaccessible	66	240,170	240,236	22,704	59,440,423	59,463,126
NC (Non Commercial)	0	236	236	0	0	0
Low Site	0	68	68	0	7,449	7,449
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Specific Geographically Defined Area	0	13	13	0	4,554	4,554
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Future Timber Harvesting Landbase	699	65,954	66,653	169,643	26,570,645	26,740,288

* Numbers may not add up exactly due to rounding

Table 2: Management Zones (some areas overlap)

Management Zone	Productive Forest	Net Area
General	175,685	19,378
Enhanced Forestry	47,829	36,556
Visual	83,993	18,492
Riparian	49,629	6,697
Wathl Community Watershed	7,395	2,639

* Numbers may not add up exactly due to rounding.

YIELD ASSUMPTIONS

The areas in the productive forest were assigned to four productivity classes (one representing the highest productivity). The four productivity classes were defined using site index values as follows:

productivity class	1	site index > 35
	2	site index > 25 and <= 35
	3	site index > 15 and ≤25
	4	site index > 3 and ≤ 15

Site index is an expression of productivity based on the height, at a specific age, of dominant and co-dominant trees in a stand. For these productivity classes, different forest types were identified in table 3. For each forest type, yield tables were prepared which describe the average timber yields expected to be produced at different ages. Two computer models were used to calculate timber yields. The Variable Density Projection (VDYP) system was used to model existing stands. The Table Interpolation Projection System for Yields (TIPSY) was used to model forest stands regenerated after logging. The BC Forest Service maintains both models.

Table 3. Definition of Analysis Units

Analysis Unit	Leading Species	Inventory Type Group	Productivity Site Class	Age Range	Net Area (ha)
1	Hemlock & Cedar	9 - 17	1,2	All	2,899
2	Hemlock & Cedar	9 - 17	3	0 - 140	13,766
3	Hemlock & Cedar	9 - 17	4	0 - 140	454
4	Hemlock & Cedar	9 - 17	3	140+	19,487
5	Hemlock & Cedar	9 - 17	4	140+	20,108
6	Balsam	18 - 20	2	All	370
7	Balsam	18 - 20	3	All	5,828
8	Balsam	18 - 20	4	All	2,991
9	Spruce	21 - 26	1,2	All	375
10	Spruce	21 - 26	3,4	All	1,524
11[3]	Lodgepole Pine	28 - 31	3,4	All	284
Total					68,086

For the yield analysis, existing volumes were obtained from VDYP generated yield curves, except for stands 141 years or older. In these ages the localized inventory database volumes were used where available. Application of these factors to VDYP derived yield curves ensured that the existing timber volumes available to the forest estate model closely matched those found in the inventory database. Table 4 shows mature volume adjustment factors derived from the re-inventory report and the average mature volumes per hectare in the database, after localization of VDYP volumes.

Table 4: VDYP Localization Factors
for Existing Stands 140 Years or Older

Leading Species	Age Class	Adjusted Factors	Localized avg VDYP vol/ha
Hemlock	8, 9	0.8057	526
Balsam	8, 9	0.7170	536
Cedar	8, 9	0.8446	467

The derivation and application of these factors was presented in detail in the TFL 41 re-inventory report.

OLD GROWTH SITE INDEX ADJUSTMENTS

Estimates of site productivity have traditionally been made using site index which is subsequently used to drive growth and yield predictions. The Site Productivity Working Group identified problems with traditional site index curve applications in old growth stands and recommended the initiation of projects to improve them. The objective was to develop adjustments for short-term application in Timber Supply Planning. Subsequently the Ministry of Forests (MoF) derived a set of interim adjustment equations for old growth site indices, Nussbaum and Nigh (1997) and Site Index Adjustment for Old-growth Coastal Western Hemlock Stands in the Kalum Forest District, Nigh, G. and B. Love, March 3, 1998. They also developed the following application guidelines for Timber Supply Analysis:

1. Adjustment equations apply only to age class 8 and 9 stands following clearcut harvest regeneration.

2. Adjustment of old growth polygons must be applied on a polygon basis before regenerated stand analysis units are formed.

3. The site index of the old growth polygon must be within the range of site index sampled to build the interim adjustment equation.

4. Old growth site index must be:

   - derived from the same species as the adjustment equation;
   - derived from the same site curves used to develop the adjustment equations,
   - derived from the height and age of the old growth polygon.

In this timber supply analysis, the SI of all Hemlock stands was adjusted by adding 10 meters for any old growth derived SI between 8 meters and 18 meters. This method is presented by the MoF in "Site Index Adjustment for Old-Growth Coastal Western Hemlock Stands in the Kalum Forest District." by G. Nigh and B. Love, March 3, 1998 (MoF Research Working Paper 27).

Site index adjustment equations for other leading species stands such as Cedar and Balsam leading were obtained from MoF Research Working Paper 36. This adjustment was applied after the net down procedure to ensure that the timber harvesting landbase was not changed. This adjustment did not change in any way the existing timber volume assigned to each old growth polygon. In the computer model, after an existing old growth stand was harvested, the new regenerated stand was assigned the adjusted site index. Future regenerated stand volumes were assigned using the adjusted site index.

HARVESTING ASSUMPTIONS

TFL 41 lies inside the coastal biogeoclimatic zones. Almost all logging is done using the clearcut system. Adjacency and green-up requirements, and stand level and landscape level biodiversity requirements were modeled in the timber supply analysis using the rules shown in tables 5 and 6. Riparian reserve and management zone requirements were also met in the analysis, by using a GIS exercise to record the area of reserve and management zone to be found in each polygon. Riparian reserve areas were allowed to contribute to wildlife tree patches. The details of the allowances for stand level biodiversity are shown in the data package, table 36.

Table 5. Area Percentage for Old Growth Seral Stage (table 34b in data package)

Group No	Landscape Unit	Biogeoclimatic			NDT	BEA	Minimum Retention Area (%)		Minimum Age
		Zone	Subzone	Variant			L45%I45%H10%	BEA	
1	Dala	CWH	vm		1	L	13.6	13	250
2	Dala	CWH	ws	2	2	L	9.4	9	250
3	Dala	MH	mm	1	1	L	19.9	19	250
4	Falls	CWH	vm		1	L	13.6	13	250
5	Falls	CWH	vm	1	1	L	13.6	13	250
6	Falls	MH	mm	1	1	L	19.9	19	250
7	Foch	CWH	vh	2	1	H	13.6	19	250
8	Foch	CWH	vm		1	H	13.6	19	250
9	Foch	MH	mm	1	1	H	19.9	28	250
10	Gilttoyees	CWH	vh	2	1	I	13.6	13	250
11	Gilttoyees	CWH	vm		1	I	13.6	13	250
12	Gilttoyees	MH	mm	1	1	I	19.9	19	250
13	Hawkesbury Island East	CWH	vh	2	1	L	13.6	13	250
14	Hawkesbury Island East	CWH	vm		1	L	13.6	13	250
15	Hawkesbury Island East	MH	wh	1	1	L	19.9	19	250
16	Hawkesbury Island West	CWH	vh	2	1	I	13.6	13	250
17	Hawkesbury Island West	CWH	vm		1	I	13.6	13	250
18	Hawkesbury Island West	MH	wh	1	1	I	19.9	19	250
19	Horetzky	CWH	ws	2	2	L	9.4	9	250
20	Horetzky	MH	mm	2	1	L	19.9	19	250
21	Hot Springs	CWH	ws	1	2	L	9.4	9	250
22	Hot Springs	CWH	ws	2	2	L	9.4	9	250
23	Hot Springs	MH	mm	2	1	L	19.9	19	250
24	Jesse - Bish	CWH	vm		1	L	13.6	13	250
25	Jesse - Bish	MH	mm	1	1	L	19.9	19	250
26	Kemano - Kildala	CWH	vm		1	I	13.6	13	250
27	Kemano - Kildala	CWH	vm	1	1	I	13.6	13	250
28	Kemano - Kildala	CWH	ws	2	2	I	9.4	9	250
29	Kemano - Kildala	MH	mm	1	1	I	19.9	19	250
30	Kemano - Kildala	MH	mm	2	1	I	19.9	19	250
31	Kitimat	CWH	vm		1	L	13.6	13	250
32	Kitimat	CWH	ws	1	2	L	9.4	9	250
33	Kitimat	CWH	ws	2	2	L	9.4	9	250
34	Kitimat	MH	mm	1	1	L	19.9	19	250
35	Kitimat	MH	mm	2	1	L	19.9	19	250
36	Kowesas	CWH	vm		1	L	13.6	13	250
37	Kowesas	CWH	vm	1	1	L	13.6	13	250
38	Kowesas	CWH	vm	2	1	L	13.6	13	250
39	Lakelse	CWH	ws	1	2	I	9.4	9	250
40	Lakelse	CWH	ws	2	2	I	9.4	9	250
41	Lakelse	MH	mm	2	1	I	19.9	19	250
42	Wedeene	CWH	vm		1	I	13.6	13	250
43	Wedeene	CWH	ws	1	2	I	9.4	9	250
44	Wedeene	CWH	ws	2	2	I	9.4	9	250
45	Wedeene	MH	mm	1	1	I	19.9	19	250
46	Wedeene	MH	mm	2	1	I	19.9	19	250

Table 5 shows two sets of parameters. One was created by assuming an area distribution rule of 45 % for both low (L) and intermediate (I) Biodiversity Emphasis Area (BEA) and 10 % for high (H) BEA, and another using the actual Biodiversity Emphasis Area distribution found in each landscape unit on the TFL. In our analyses we used the 45/45/10 split.

Table 6. Area Percentage for Green-up
(table 34a in data package)

GROUP NO	SWG MGMT ZONE	VQO	Green-up Height (meters)	Current Operable Landbase Green-up Area %	Productive Landbase Green-up Area %
47	General		3	35	4.01
48	Enhanced		3	35	28.05
49	Visual	R	5	5	1.51
50	Visual	PR	5	15	14.73
51	Visual	M	5	25	11.05
52	Riparian		5	25	3.47
53	Wathl watershed		9	25	9.10

RESULTS

Harvest forecasts were made for the following landbases:

- gross productive landbase;
- planned management timber harvesting landbase;
- conventional timber harvesting landbase.

For the above landbases, the maximum even flow harvest AAC was calculated. In addition, step down harvests were calculated beginning with the present allowable cut of 400,000 cubic metres per year. In these cases the step down in any one decade was restricted to a maximum of ten percent of the previous decade's harvest level. Sensitivity analyses around the maximum even flow level and step down basecase runs for the planned management, conventional and constrained conventional landbases were also conducted. Tables 7-8 show the complete set of 55 even flow harvest forecasts and 54 step down harvest forecasts, respectively.

The planned management represents the management assumptions adopted by Skeena Sawmills Ltd. This includes:

- a portion of the non-conventional landbase,
- a six percent reduction for roads, trails and landings,
- old growth site index conversion for hemlock and balsam inside and outside the CWH zone.

The gross productive landbase runs included the same assumptions as planned management except for the landbase.

The conventional landbase runs included the same assumptions as planned management except that all non-conventional areas are excluded.

Constrained conventional management assumes a conventional landbase, an eight percent reduction for roads, trails and landings, and old growth site index conversions for hemlock in the CWH zone only.

Comparison of the results on the basecase runs from the two biodiversity emphasis area %'s in table 5 showed no significant difference. Therefore, in the following 108 different computer harvest forecasts, percentages of old growth retention area were calculated assuming a biodiversity emphasis distribution of 45/45/10.

In tables 7-8 run numbers 3, 21 and 39 are even flow basecase runs, and 56, 74 and 92 are step down basecase runs. Other runs are sensitivity analyses about even flow and step down basecase runs. Except for run number 1, every run in tables 7-8 applied the cover constraints and biodiversity modeling described previously in the section entitled 'Harvesting Assumptions'.

Table 7: The Complete Set of Even Flow Harvest Forecasts
(OGSI adjusted for AU4, 5, 7, and 8 except for #'s 17, 35
and 39-55 adjusted for AU 4 and 5 only)

Sensitivity Analyses	Run # for following landbase			
	Gross Operable Landbase	Planned Management	Conventional	Constrained Conventional
Unconstrained by green-up or cover constraints	1			
Constrained by green-up or cover constraints	2			
Maximum even flow		3	21	39
Existing stand volume +10%		4	22	40
Existing stand volume –10%		5	23	41
Regenerated stand volume +10%		6	24	42
Regenerated stand volume –10%		7	25	43
Cover constraint percentages +10%		8	26	44
Cover constraint percentages –10%		9	27	45
Minimum harvest age +10 years		10	28	46
Minimum harvest age –10 years		11	29	47
Green-up heights +2 metres		12	30	48
Green-up heights –2 metres		13	31	49
No visual constraints		14	32	50
Landbase increased by 10%		15	33	51
Landbase decreased by 10%		16	34	52
Hemlock SI adjustment only		17	35	
No old growth site index adjustment - all species		18	36	53
		19	37	54
No wildlife tree patches		20	38	55
Use 95% of the culmination MAI as the minimum harvestable age criteria				

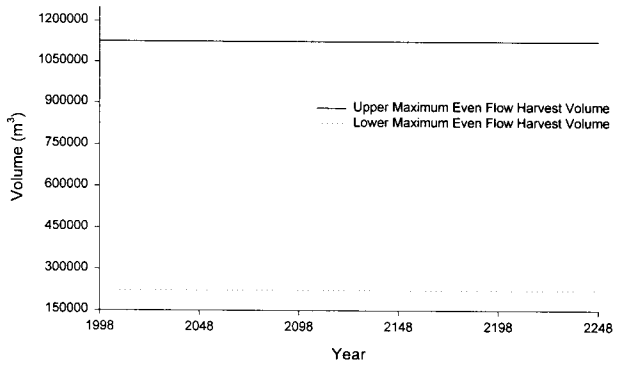
Table 8: The Complete Set of Step Down Harvest Forecasts
(OGSI adjusted for AU4, 5, 7, and 8 except for #'s 70, 88
and 92-108 adjusted for AU 4 and 5 only)

Sensitivity Analyses	Run # for following landbase		
	Planned Management	Conventional	Constrained conventional
Step down	56	74	92
Existing stand volume +10%	57	75	93
Existing stand volume –10%	58	76	94
Regenerated stand volume +10%	59	77	95
Regenerated stand volume –10%	60	78	96
Cover constraint percentages +10%	61	79	97
Cover constraint percentages –10%	62	80	98
Minimum harvest age +10 years	63	81	99
Minimum harvest age –10 years	64	82	100
Green-up heights +2 metres	65	83	101
Green-up heights –2 metres	66	84	102
No visual constraints	67	85	103
Landbase increased by 10%	68	86	104
Landbase decreased by 10%	69	87	105
Hemlock SI adjustment only	70	88	
No old growth site index adjustment - all species	71	89	106
No wildlife tree patches	72	90	107
Use 95% of the culmination MAI as the minimum harvestable age criteria	73	91	108

THE FEASIBLE RANGE OF HARVESTS

When even flow harvest levels are calculated, run number 1 in table 7 has the highest even flow value at 1,126,062 cubic meters per year (net non-recoverable losses) and run number 53 has the lowest at 223,002 cubic meters. The Theoretical range of even flow harvests lies between these two. Figure 1 illustrates the feasible range.

Figure 1: Feasible Range of Even Flow Harvests



As figure 1 shows, there is a very wide range of choices available in setting the rate of harvest for TFL 41. Each choice is supported by a different landbase for timber production and a different set of assumptions.

THE GROSS PRODUCTIVE LANDBASE

The gross productive landbase includes all the land under continuous forest cover plus recently logged land. To calculate a potential timber supply, non-commercial, deciduous areas and existing and future roads were excluded from the gross productive landbase. In predicting yields for this landbase, old growth site index adjustments were made for hemlcok and balsam stnads. When no cover constraints are applied to this landbase, the even flow harvest is 1,126,062 cubic meters per year. This number represents a theoretical maximum harvest schedule. Using the present ideas about cover constraints (green-up and adjacency) and biodiversity that are dictated by the Ministry of Forests, the result for gross productive landbase became 543,475 cubic meters per year.

For the gross productive landbase, these results show that cover constraints reduce the even flow annual harvest by about 51.7% (543,475 cubic meters versus 1,126,062 cubic meters).

THE PLANNED MANAGEMENT LANDBASE

The planned management landbase includes the land on which logging can take place, after removals from the timber harvesting landbase have been made for inoperable areas, non-commercial cover, low sites, deciduous areas, non-merchantable areas, environmentally sensitive areas, alpine tundra, riparian reserves and management zones, specific geographically defined area, unclassified roads, trails and landings, wildlife tree patches, and not sufficiently restocked areas.

Under the green-up, adjacency and biodiversity rules applied in this analysis, the maximum even flow harvest on the planned management landbase was calculated to be 327,849 cubic meters per year, net non-recoverable losses. The present allowable harvest rate is 400,000 cubic metres per year.

To provide a different perspective another projected harvest pattern, different from the even flow harvest, was investigated for the planned management landbase. This harvest pattern began with an initial harvest target for the first 30 years, of 400,000 followed by a step down in harvest levels to a long run harvest level. For the planned management landbase the annual harvest rate for the next 30 years can be maintained at 400,000 cubic meters before stepping down to a level of 323,620 and then climbing back up to 510,500 cubic meters. Figure 2 and Table 9 show both harvest patterns, the even flow and the step down harvest.

Figure 2: Comparison of Annual Even Flow Harvest
and Step Down Harvest in the Planned Management Landbase

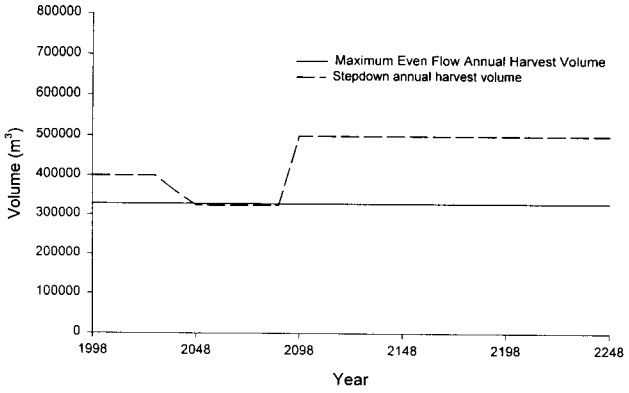


Table 9: Two Different Harvest Patterns for
the Planned Management Landbase (net of non-recoverable losses)

Annual Harvest (cubic meters)		
Decade	Even flow	Step down
1	327,849	400,000
2	327,849	400,000
3	327,849	400,000
4	327,849	359,800
5	327,849	323,620
6	327,849	323,620
7	327,849	323,620
8	327,849	323,620
9	327,849	323,620
10	327,849	510,500
11	327,849	510,500
12	327,849	510,500
13	327,849	510,500
14	327,849	510,500
15	327,849	510,500
16	327,849	510,500
17	327,849	510,500
18	327,849	510,500
19	327,849	510,500
20	327,849	510,500
21	327,849	510,500
22	327,849	510,500
23	327,849	510,500
24	327,849	510,500
25	327,849	510,500
250 Year Total	81,962,250	113,459,000

Over the 250-year period the step down harvest pattern produces more timber. The difference (31,496,750 cubic meters) represents an average of 125,987 cubic meters per year.

Standing Reserves of Green Timber

The trees that are not harvested are continually growing and provide standing reserves of green timber. Figures 3 and 4 provide information on these timber reserves.

Figure 3: Planned Management Landbase Even Flow Harvest and Projected Total Inventory Volume

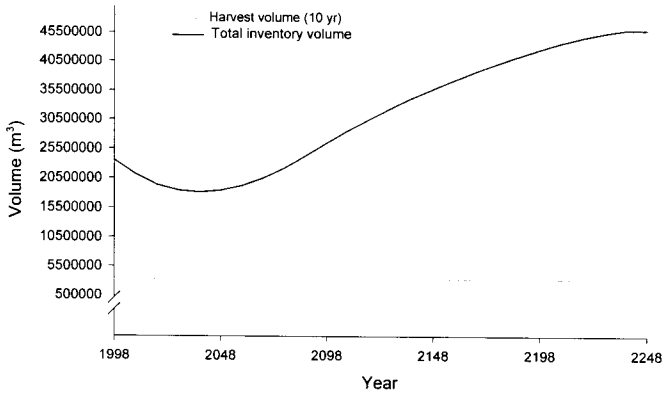
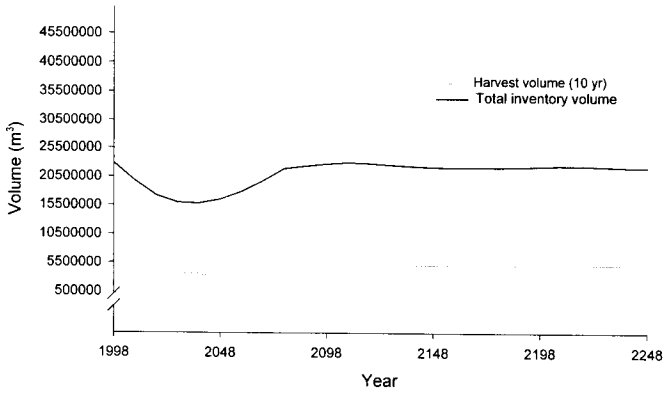


Figure 4: Planned Management Landbase Step Down Harvest and Projected Total Inventory Volume



The top line in the graphs in figure 3 and 4 shows the standing volume of timber at any time in the timber harvesting landbase for all age classes. This volume includes timber not yet ready for harvest and harvestable timber. The bottom line shows the total volume of timber harvested in each decade. Because figures 3 and 4 represent the same landbase, the standing reserves of total and merchantable timber are the same in 1998.

Standing timber reserves increase dramatically over time under the even flow harvest (see figure 3). This happens because, after 50-60 years from now, this rate of harvest is significantly less than the forecasted growth rates.

Distribution of Seral Stages

Biological diversity (biodiversity) is the diversity of plants, animals and other living organisms.

Our task in this report is to try to conform with the MoF interpretation of guidelines laid out in a government book entitled "Forest Practices Code of British Columbia, Biodiversity Guidebook."

The fashion is to specify required forest age class minimum area percentages for the old seral stages. These requirements are given in the biodiversity guidebook according to resource planning unit, natural disturbance type, biogeoclimatic zone, biodiversity emphasis and age.

Natural disturbance type (NDT) classifies a landscape unit according to how frequently forest stands were destroyed and replaced by nature or aboriginal actions prior to European contact. The period between these events represents the stand life-span or rotation. For example, NDT 1 is a label for ecosystems with rare stand initiating events. The guidebook defines rare as equal to a rotation of 250 years for coastal western hemlock (CWH) and Interior cedar/hemlock (ICH) biogeoclimatic zones, and 350 years for the Engelmann spruce/subalpine fir (ESSF) and mountain hemlock (MH) biogeoclimatic zones.

Biodiversity emphasis is a label for the amount of modification allowable by modern society from the hypothetical pre-European state that can occur without increasing the guidebook authors' perceived risk of losing native species. A label of low biodiversity emphasis is seen as being riskier than one of high biodiversity emphasis because the low emphasis allows more modification. More modification usually produces a more diverse range of forest conditions which, according to the guidebook, results in a less diverse range of native species.

Three seral stages are defined in the Biodiversity Guidebook as early, mature and old. The cut-off ages for each stage differ for each natural disturbance type and biogeoclimatic zone. Then, with each seral stage different required minimum percentages are specified by biodiversity emphasis label.

In TFL 41 there are fourteen resource planning/landscape units, three biogeoclimatic zones and two natural disturbance types. Table 5 shows the old growth preservation requirements used in the timber supply analysis.

Figures 5 - 10 show the results of meeting MoF requirements for the gross productive landbase, when an even flow harvest of 327,849 cubic metres is taken from the planned management landbase. For each landscape unit there is a graph showing the proportion of old

growth in the TFL 41 gross productive landbase. Figures 11 - 16 show the same thing for the step down harvest from the planned management landbase.

These graphs show that, when a landscape unit begins with old growth areas above the minimum requirement, they never fall below it.

Figure 5: Even Flow Harvest, Percentages of Old Seral Stages in the Gross Productive Landbase

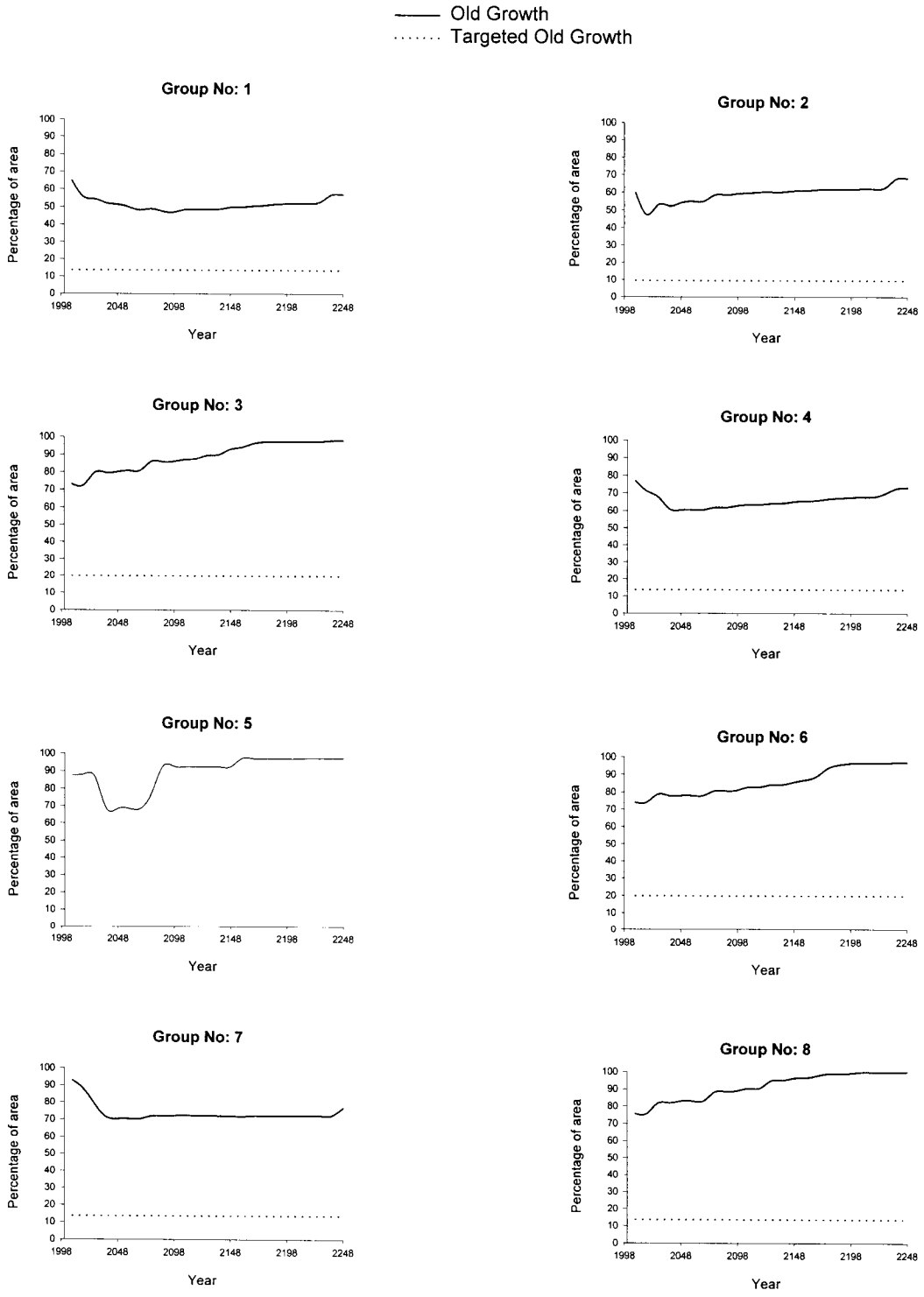


Figure 6: Even Flow Harvest, Percentages of Old Seral Stages in the Gross Productive Landbase

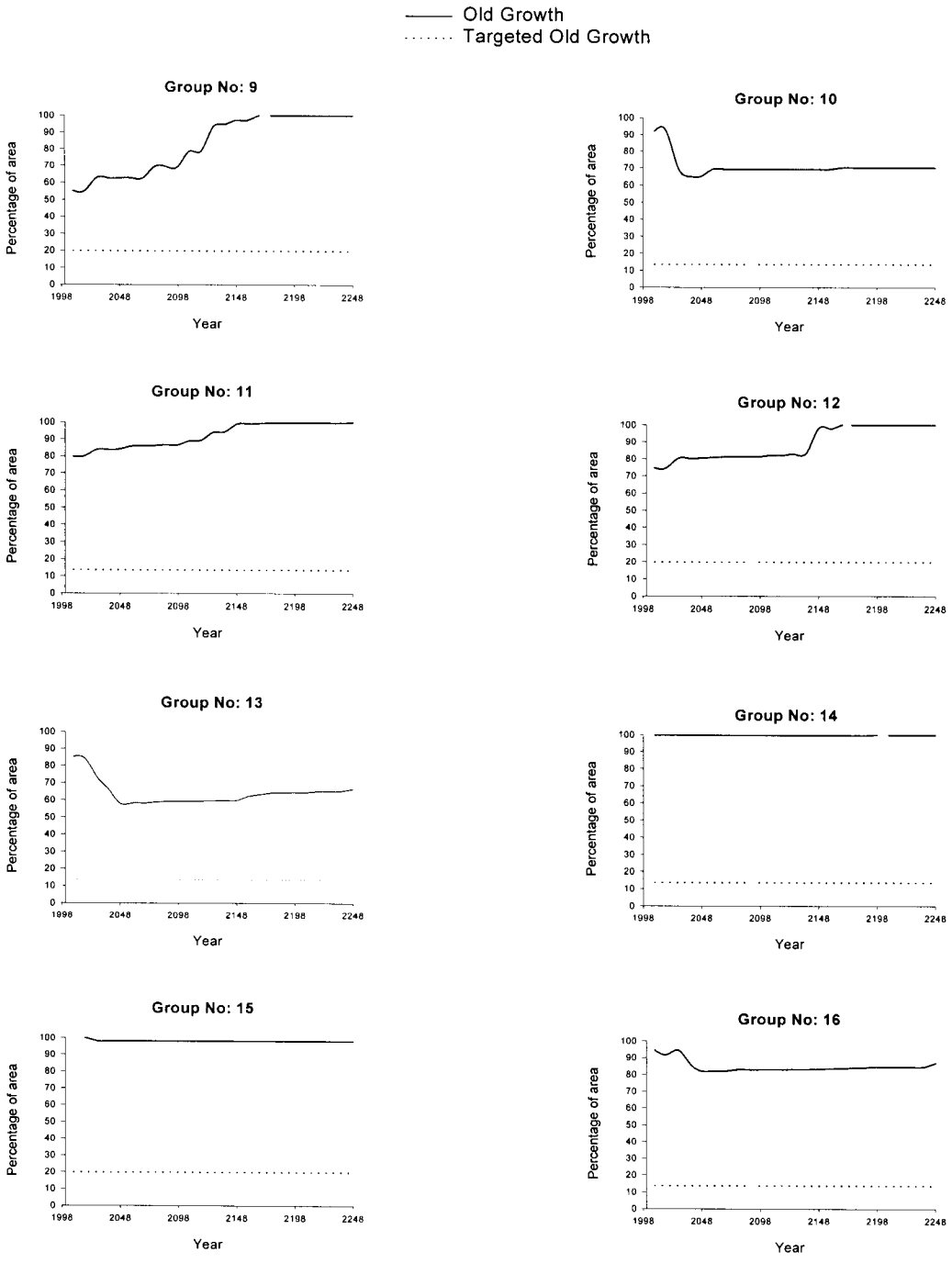


Figure 7: Even Flow Harvest, Percentages of Old Seral Stages in the Gross Productive Landbase

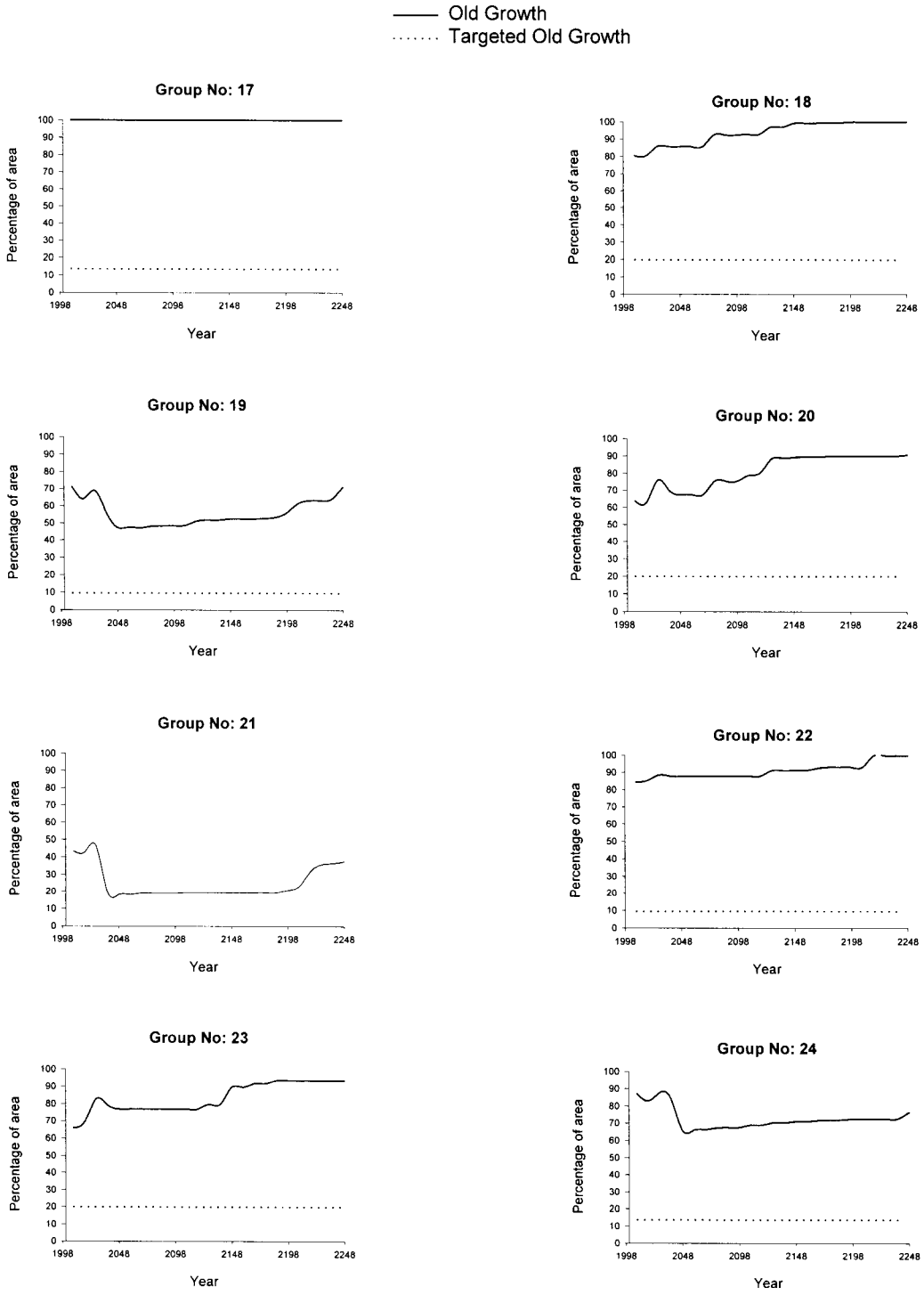


Figure 8: Even Flow Harvest, Percentages of Old Seral Stages in the Gross Productive Landbase

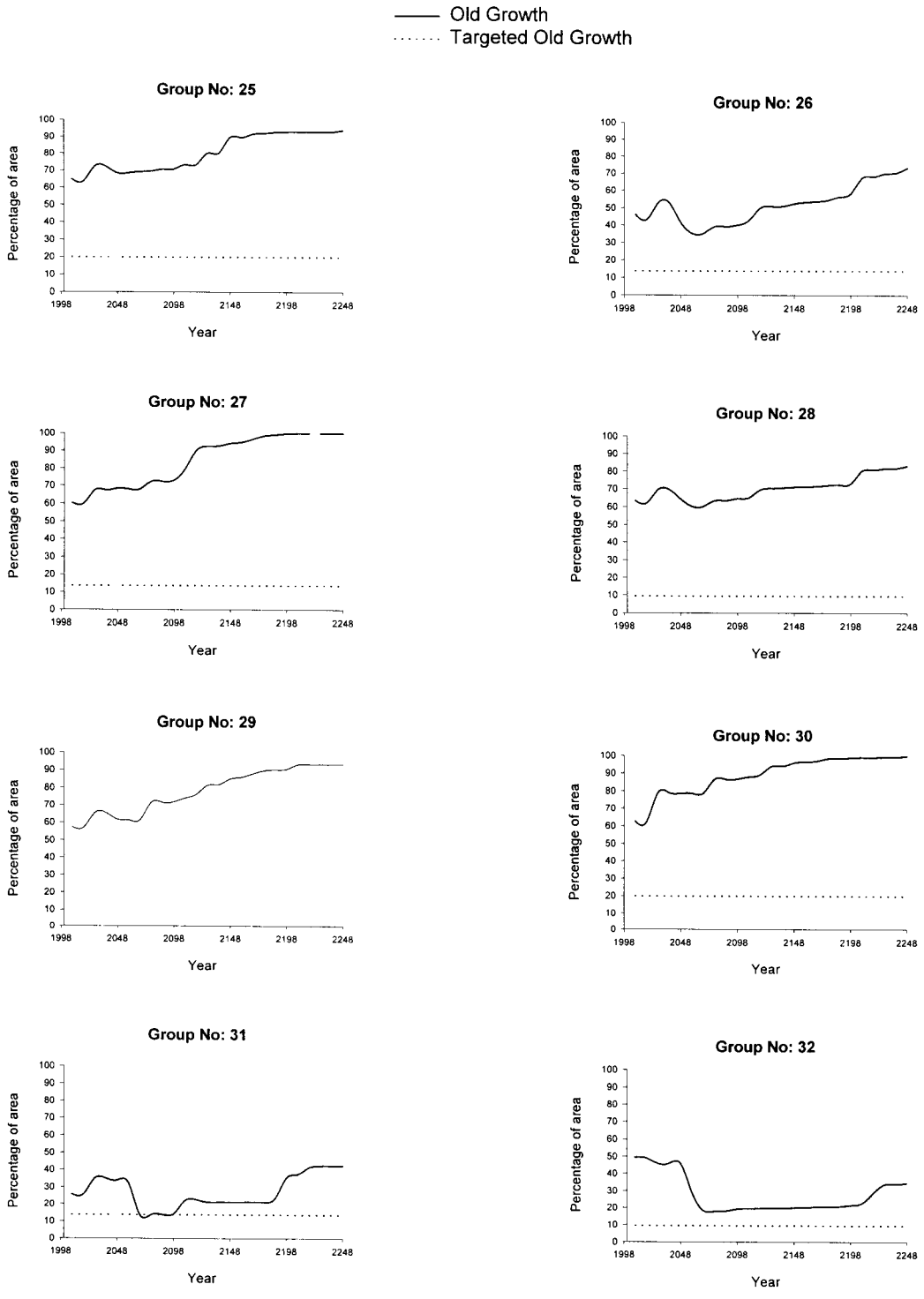


Figure 9: Even Flow Harvest, Percentages of Old Seral Stages in the Gross Productive Landbase

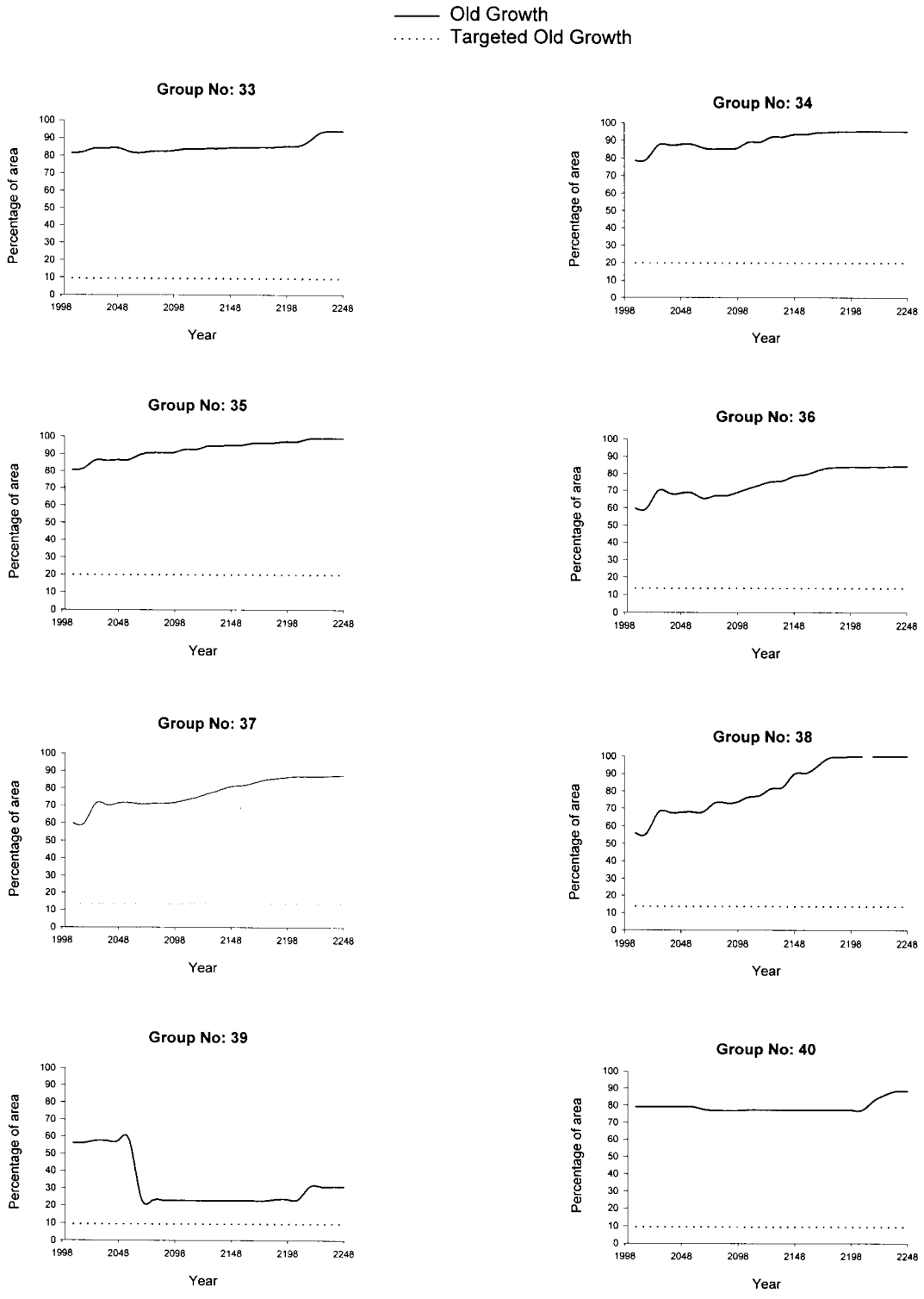


Figure 10: Even Flow Harvest, Percentages of old Seral Stages in the Gross Productive Landbase

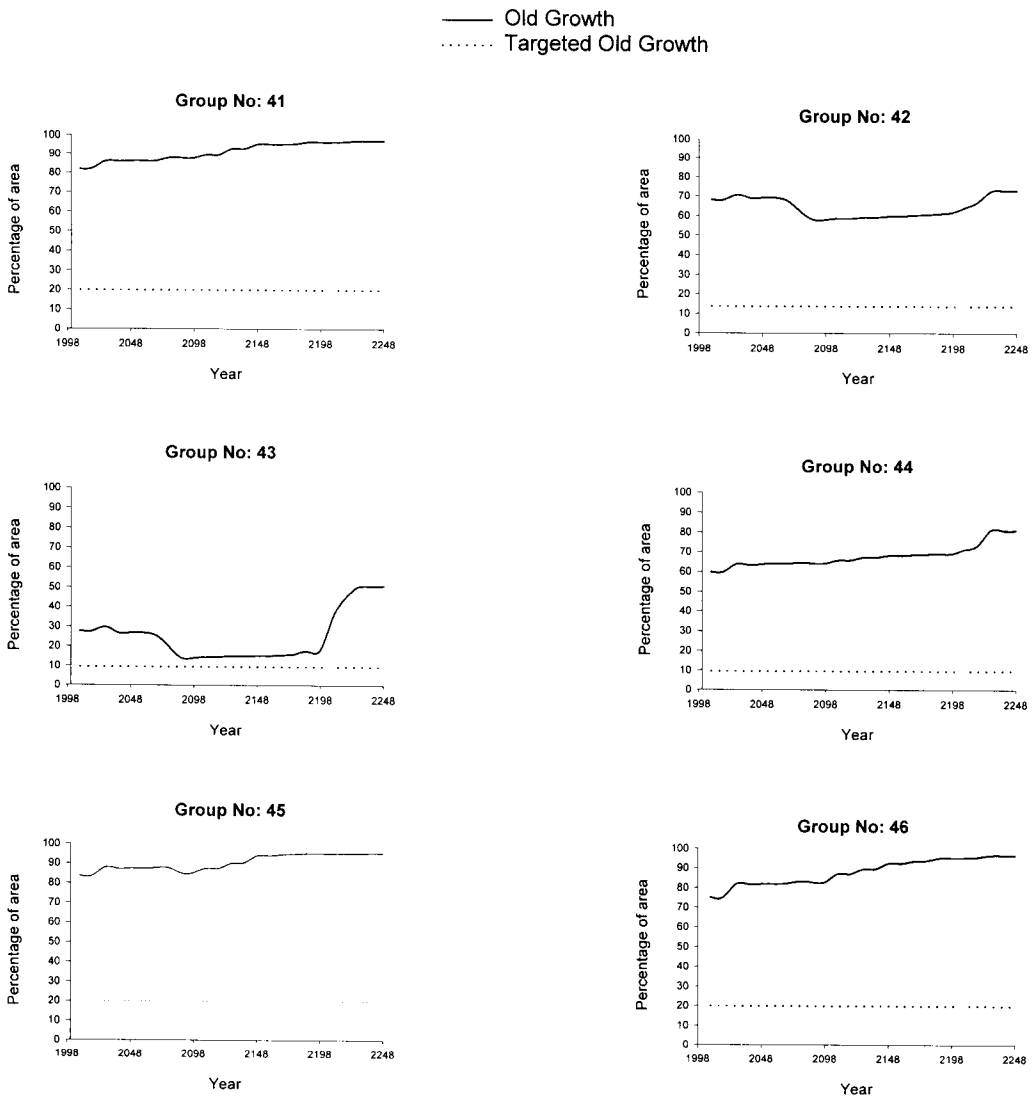


Figure 11: Step Down, Percentages of Old Seral Stages in the Gross Productive Landbase

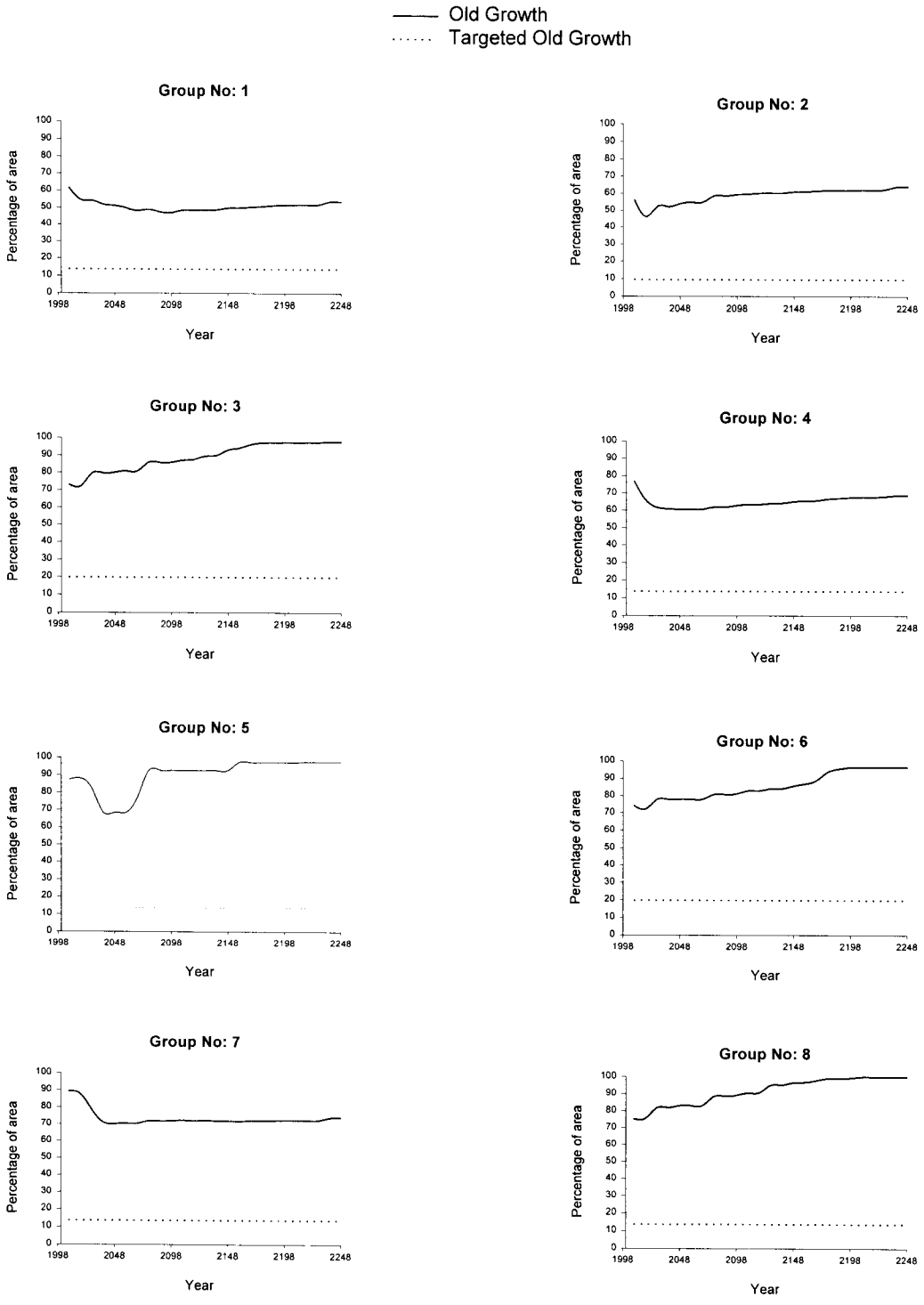


Figure 12: Step Down, Percentages of Old Seral Stages in the Gross Productive Landbase

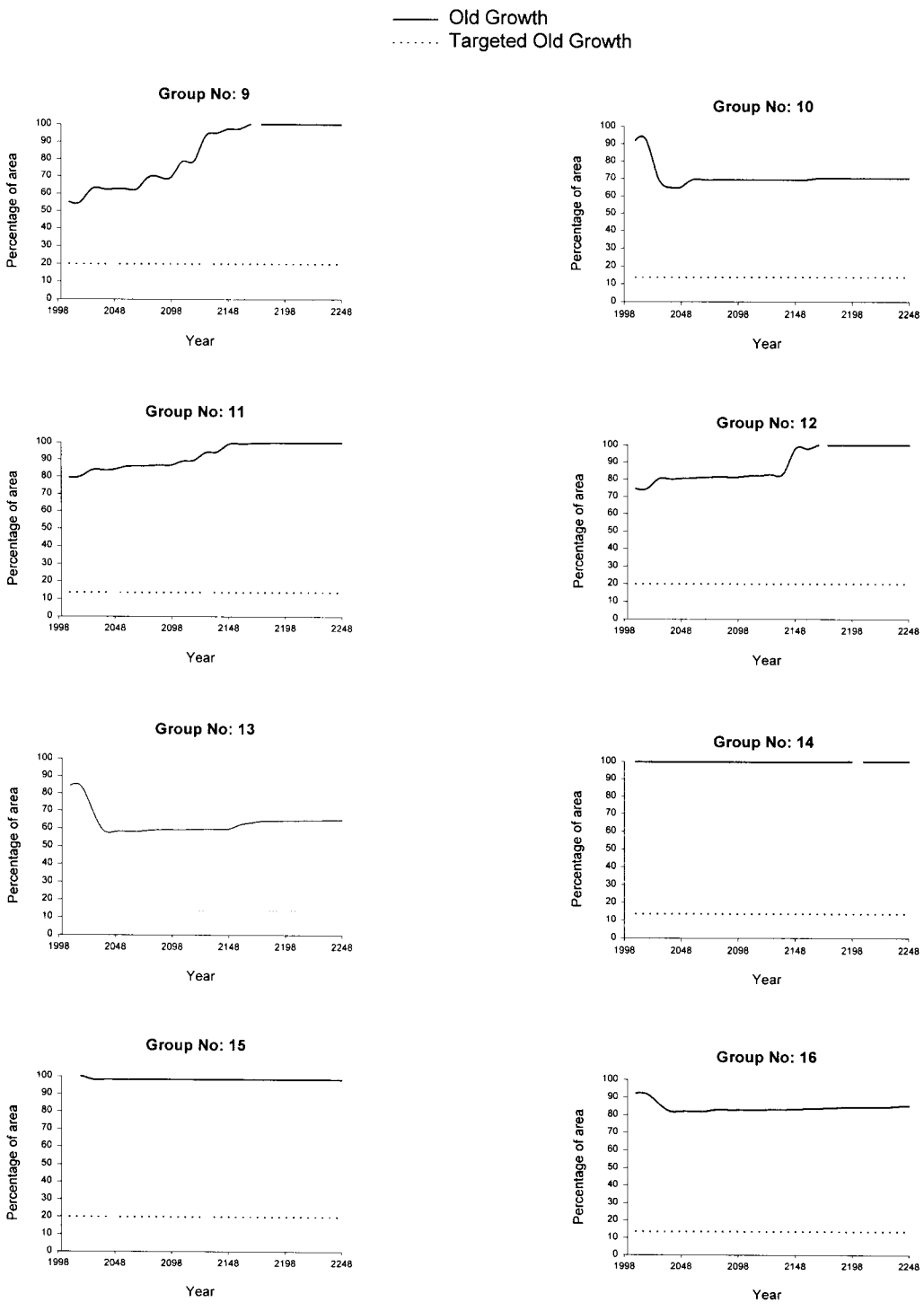


Figure 13: Step Down, Percentages of Old Seral Stages in the Gross Productive Landbase

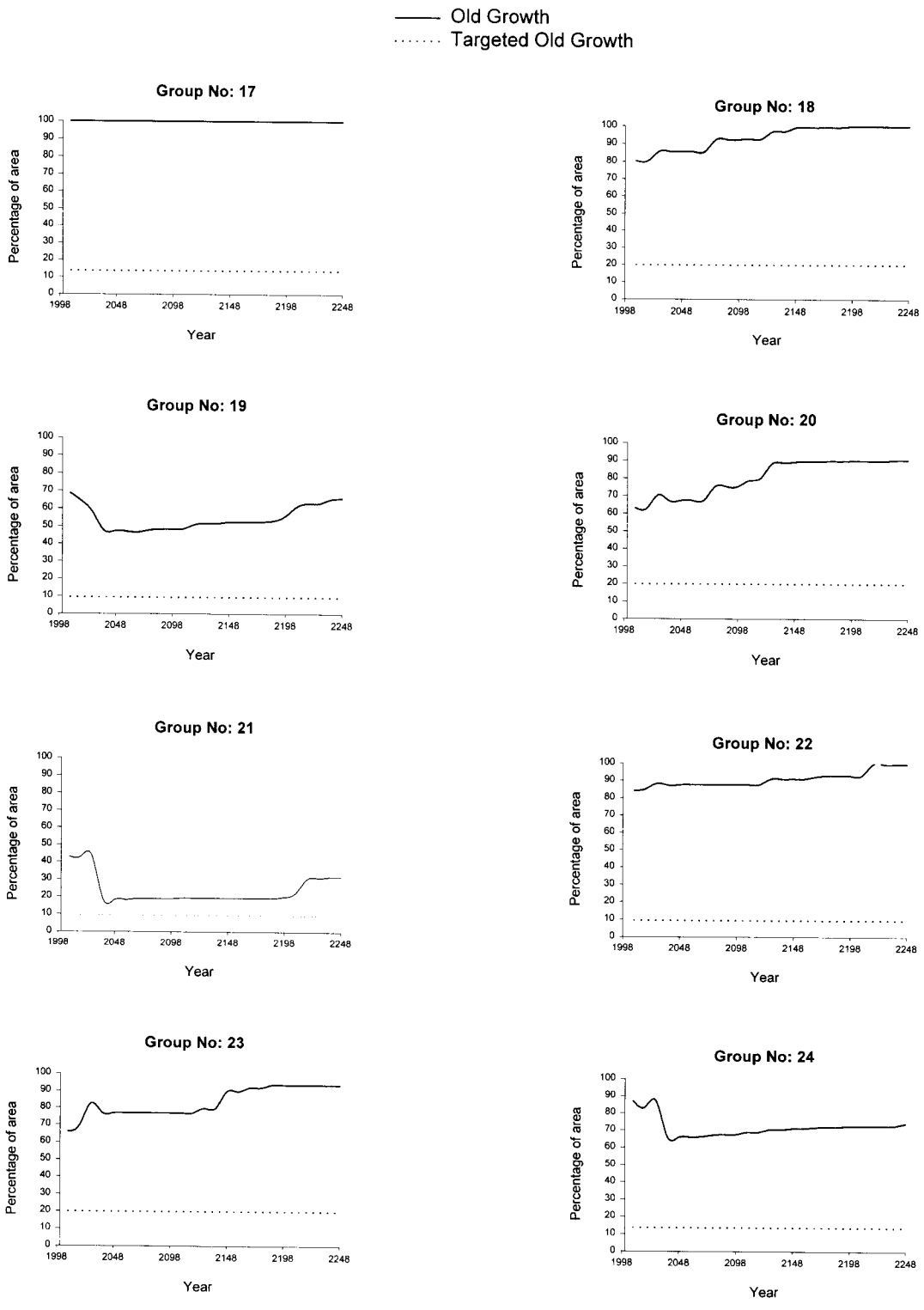


Figure 14: Step Down, Percentages of Old Seral Stages in the Gross Productive Landbase

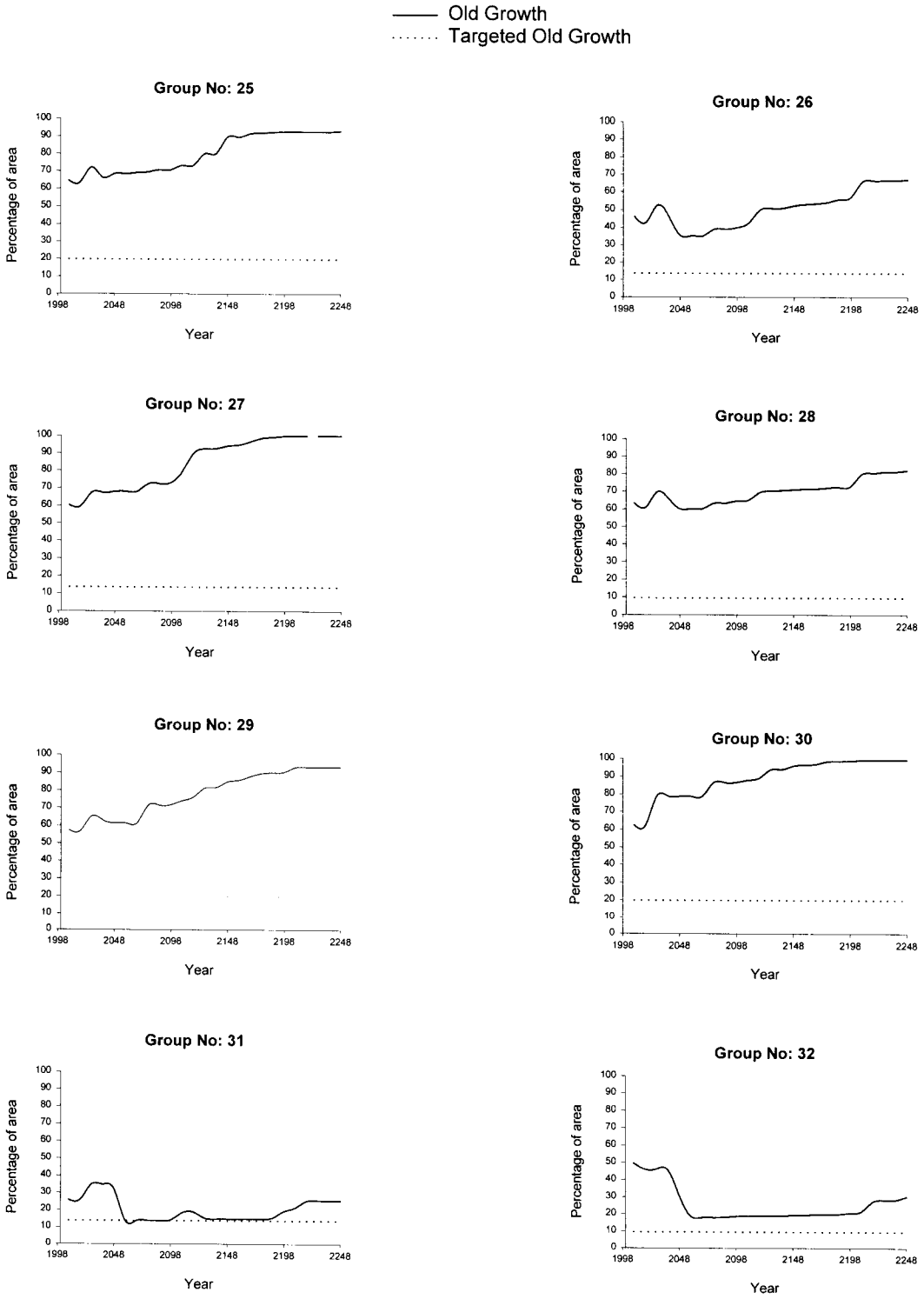


Figure 15: Step Down, Percentages of Old Seral Stages in the Gross Productive Landbase

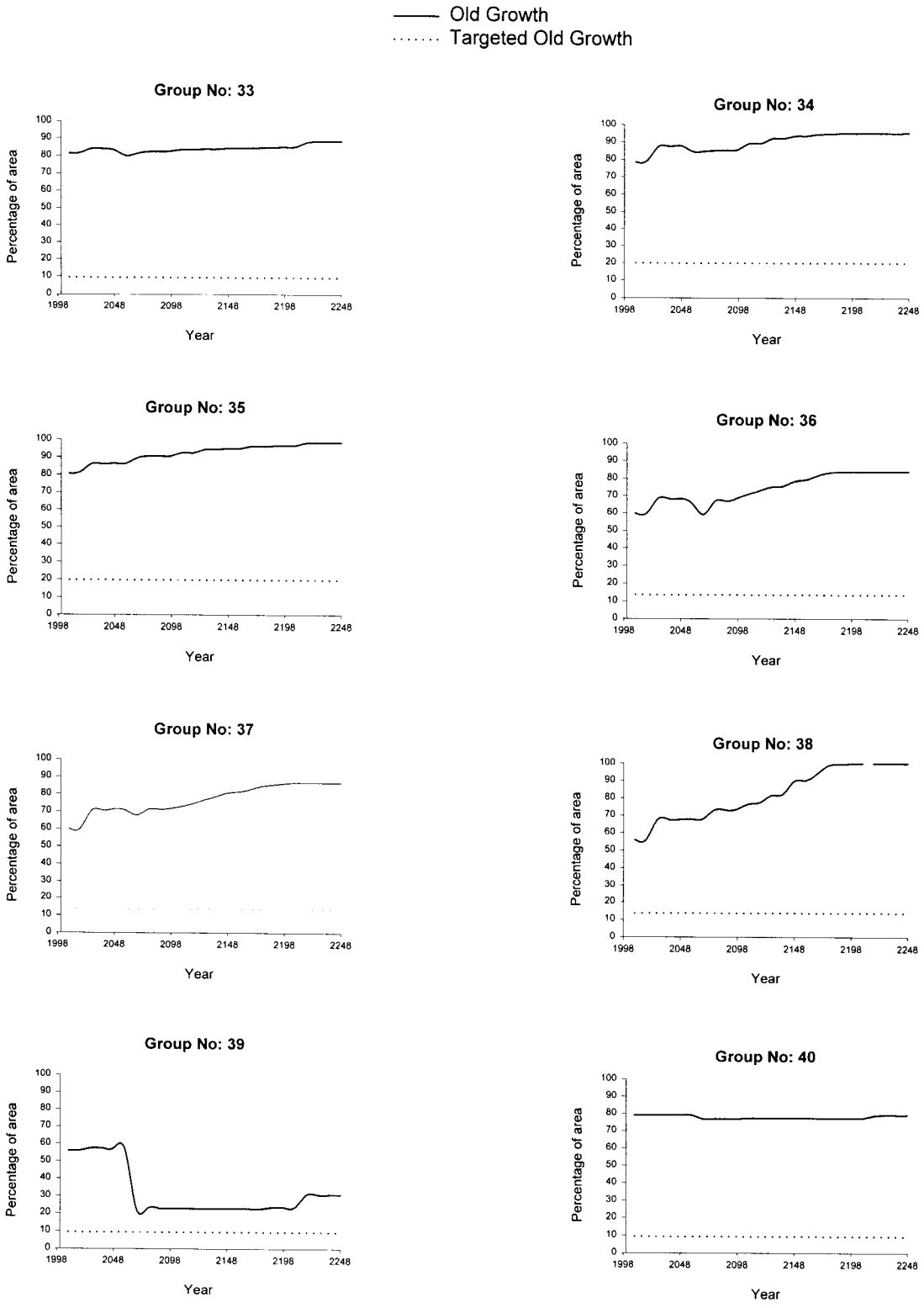
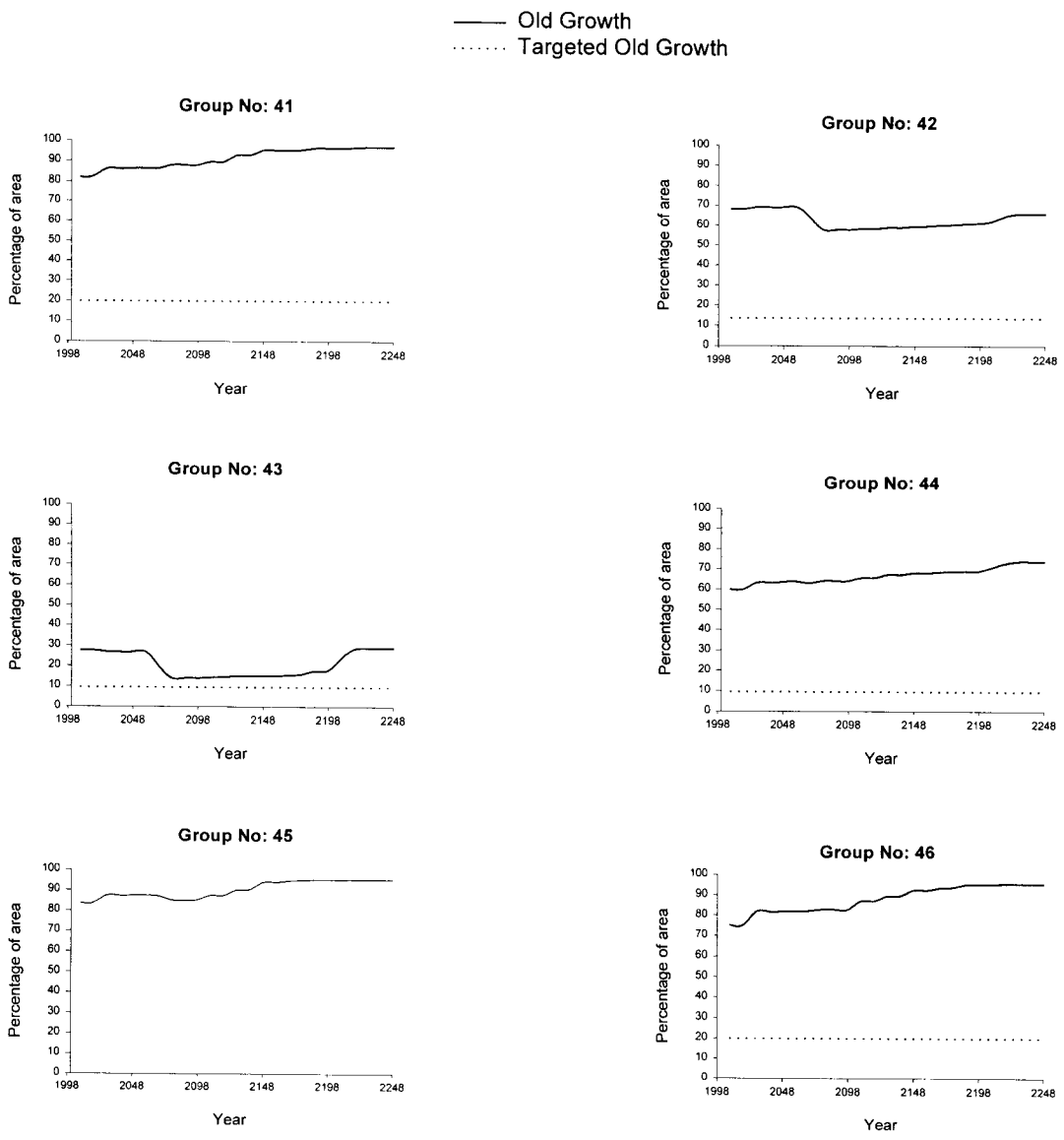


Figure 16: Step Down, Percentages of Old Seral Stages in the Gross Productive Landbase



Green-up Constraints

In the computer model, green-up and adjacency constraints are modelled as follows:

1. a green-up period after logging is defined during which time the new replacement stands are expected to reach a specified height.

2. a maximum allowable area is defined for replacement stands which are below the green-up height specified in (1) above.

The allowable area, expressed as a percentage, implies a specific multipass logging system. The green up period is the time between passes. A green-up period of 15 years with a four pass logging system implies a 60 year period in which to harvest presently mature timber.

Maximum age or green-up constraints were first expressed in terms of the net landbase and then equivalent constraints were calculated for and applied to the gross productive landbase. The maximum age cover constraints and equivalent green-up heights are shown in table 6.

Figure 17 shows the actual compared with the maximum allowable areas less than green-up age produced by the computer model during the even flow harvest run for the planned management landbase. Figure 18 shows the same information for the stepdown harvest. In figures 17 and 18, the dotted line in each graph shows the maximum allowable percentage for each area. The solid line in each graph shows the actual area in the computer model. The maximum allowable area can only be exceeded if the initial area happens to be above that allowed in the future. In figure 18 logging in four of the zones produces the maximum allowable area below green-up age. These zones contain uncut merchantable timber which is not available due to cover constraints. That is, the application of cover constraints restricts the harvest from the visual retention, partial retention modification, and Wathl community watershed zones. In the enhanced, general, and modification zones logging does not produce the maximum allowable area below green-up. These latter three zones have long periods where all the merchantable timber has been harvested by the computer model, but there is not enough merchantable timber available to harvest up to the maximum allowed by the cover constraints.

Figure 17: Percentages of Below Green-Up Age Areas for Even Flow Harvest, Planned Management

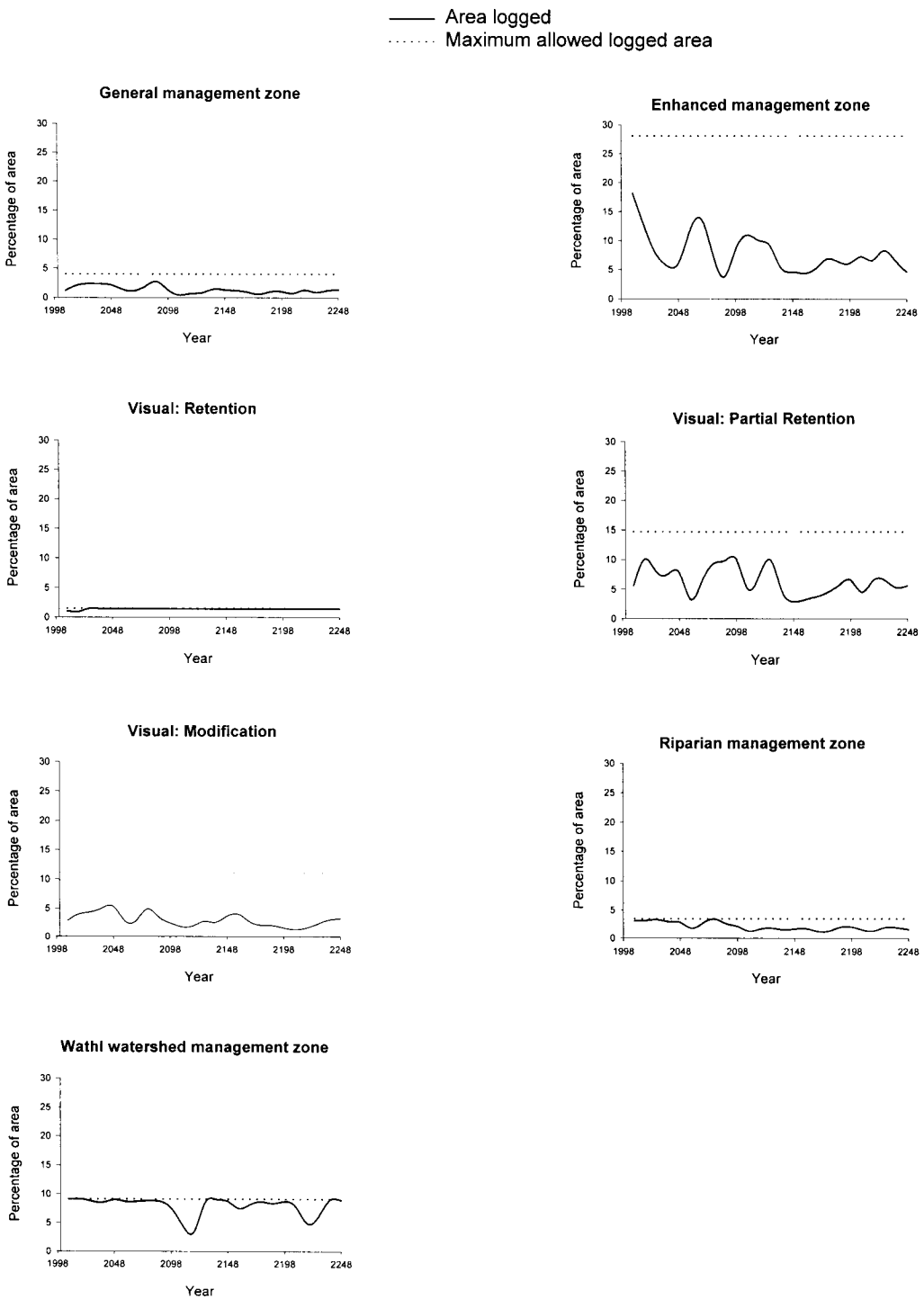
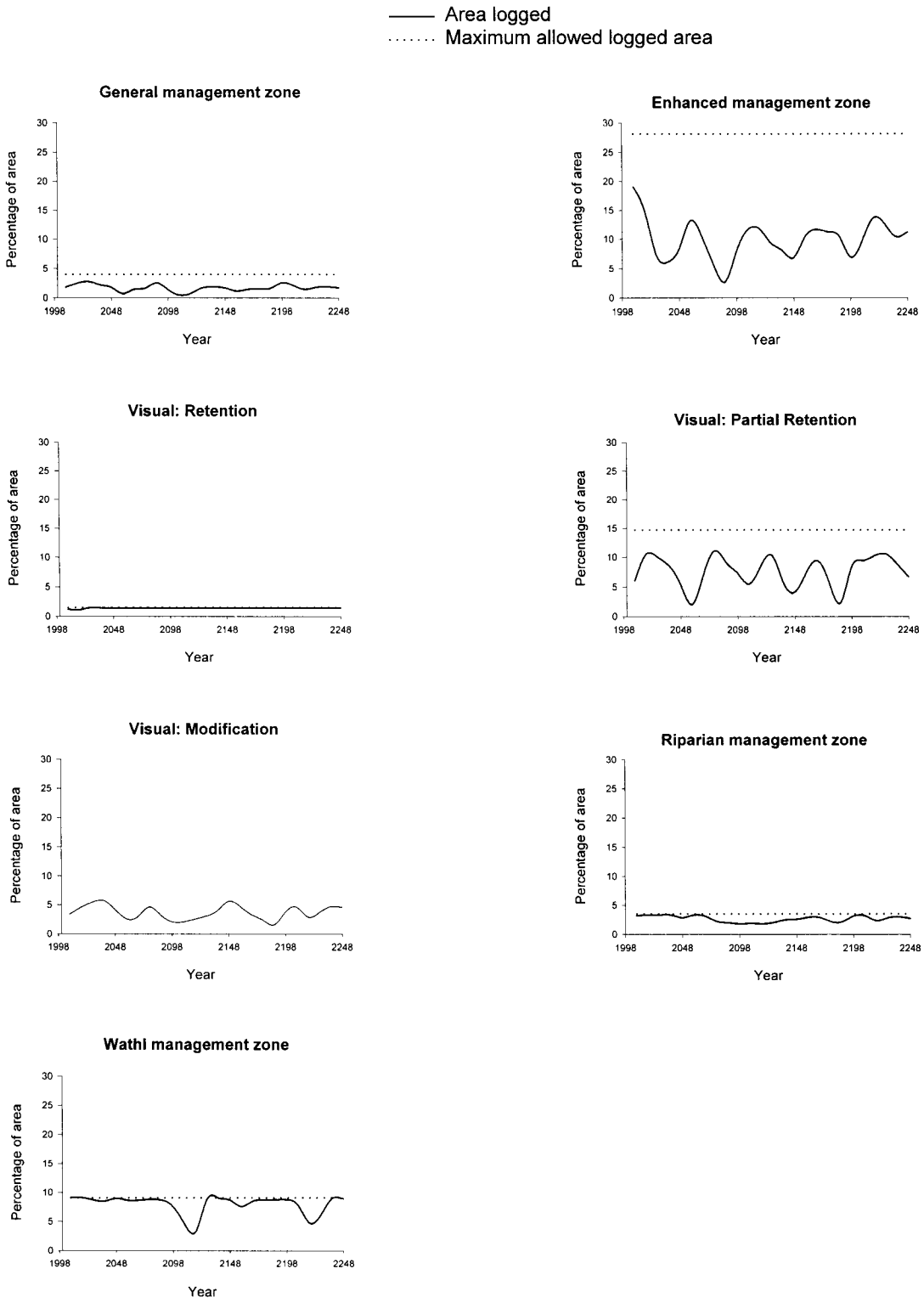


Figure 18: Percentages of Below Green-Up Age Areas
for Step Down Harvest, Planned Management



SENSITIVITY ANALYSES

Sensitivity analyses were carried out on the gross productive, planned management and conventional and constrained conventional landbases. Sensitivity analysis is a way to see how the harvest schedule changes when assumptions about landbase, forest yield and other factors are changed.

Even Flow Sensitivity Analysis

Table 10 below summarizes the sensitivity analysis results done for even flow harvest schedules.

Table 10 shows that the even flow harvest on the planned management, conventional and constrained conventional landbases is most sensitive to:

- changes in the stand volume estimates,
- changes in OGSI adjustments.
- changes in the landbase, and
- changes in the minimum harvestable age.

Table 10: Even Flow Sensitivity Analysis Results
(net non-recoverable losses)

Description	Gross Productive landbase		Planned Management		Conventional Landbase		Convention and Constrained Conventional	
	Annual harvest volume m^3 /year	% difference from base run	Annual harvest volume m^3 /year	% difference from base run	Annual harvest volume m^3 /year	% difference from base run	Annual harvest volume m^3 /year	% difference from base run
Base Runs	543,475		327,849		299,870		292,433	
Yield Tables								
Existing Stand Volume + 10%			355,664	+8.5	324,955	+8.4	317,089	+8.4
Existing Stand Volume - 10%			300,009	-8.5	274,819	-8.4	267,693	-8.5
Regenerated Stand Volume + 10%			333,045	+1.6	305,064	+1.7	297,119	+1.6
Regenerated Stand Volume - 10%			322,634	-1.6	294,739	-1.7	287,602	-1.7
Hemlock SI adjustment only			324,291	-1.1	296,332	-1.2	292,433	0.0
No old growth SI adjustment for all species			243,106	-25.8	227,678	-24.1	223,002	-23.7
Cover Constraints								
Cover constraint percentages + 10%			327,991	+0.0	299,931	+0.0	292,441	+0.0
Cover constraint percentages - 10%			327,991	+0.0	299,789	+0.0	292,411	+0.0
Green-up Heights + 2 meters			327,991	+0.0	299,815	+0.0	292,415	+0.0
Green-up Heights - 2 meters			327,991	+0.0	299,732	+0.0	292,415	+0.0
No Visual Zone			327,890	+0.0	299,919	+0.0	292,354	+0.0
No Cover Constraints	1,126,063	+107.0	327,946	+0.0	299,732	+0.0	292,415	+0.0
Minimum Harvest Age								
Minimum Harvest Age + 10 years			283,610	-13.5	260,160	-13.2	250,706	-14.3
Minimum Harvest Age - 10 years			360,162	+9.9	329,254	+9.8	319,372	+9.2
Use 95% of the culmination MAI as minimum harvestable age criteria			318,473	-2.9	290,694	-3.1	283,297	-3.1
Landbase								
Current Landbase Increased by 10%			360,791	+10.0	329,922	+10.0	321,803	+10.0
Current Landbase Decreased by 10%			294,933	-10.0	269,810	-10.0	262,910	-10.1
No Wildlife Tree Patches			335,884	+2.5	307,784	+2.6	299,752	+2.5

Step Down Sensitivity Analysis

Sensitivity analyses for stepdown harvest schedules were constructed for the planned management landbase, the conventional landbase and the constrained conventional landbase. As found previously with the even flow sensitivity runs, the stepdown sensitivity runs were most sensitive to:

- changes in the stand volume estimates,
- changes in OGSI adjustments,
- changes in the landbase,
- changes in the minimum/harvestable age.

Table 11 - 13 summarize sensitivity analyses done for step down harvest schedules.

Table 11: Step Down Sensitivity Analysis Results on the Planned Management Landbase

Decade	Base case	OGSI adjusted Hemlock only	No OGSI Adjustment	Existing stand volume +10%	Existing stand volume -10%	Regen stand volume +10%	Regen stand volume -10%	95% CMAI min_harves table age	Minimum harvest age +10 years	Minimum harvest age -10 years	Landbase +10%	Landbase - 10%	Green-up Height+ 2m	Green-up Height- 2m	No Visual Zone	No Wildlife Tree Patch
1	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000
2	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000
3	400,000	400,000	359,800	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	359,800	400,000	400,000	400,000	400,000
4	359,800	359,800	323,620	400,000	359,800	400,000	359,800	359,800	359,800	400,000	400,000	323,620	359,800	359,800	359,800	400,000
5	323,620	323,620	291,058	400,000	323,620	359,800	323,620	323,620	323,620	400,000	400,000	291,058	323,620	323,620	323,620	359,800
6	323,620	323,620	261,752	359,800	323,620	323,620	323,620	323,620	323,620	400,000	400,000	291,058	323,620	323,620	323,620	323,620
7	323,620	323,620	235,377	359,800	323,620	323,620	323,620	323,620	323,620	400,000	400,000	291,058	323,620	323,620	323,620	323,620
8	323,620	323,620	211,639	323,620	147,982	323,620	323,620	323,620	323,620	357,893	359,800	291,058	323,620	323,620	323,620	323,620
9	323,620	323,620	211,639	323,620	238,482	323,620	314,273	274,541	142,475	350,198	359,800	246,207	287,604	323,620	323,620	323,620
10	510,500	448,840	211,639	510,500	470,598	523,803	424,802	400,572	82,882	510,500	534,754	416,365	486,161	511,500	511,800	523,500
11	510,500	505,160	211,639	510,500	508,220	548,833	503,319	506,028	224,831	510,500	550,096	439,978	510,500	511,500	511,800	523,500
12	510,500	510,500	211,639	510,500	510,500	550,200	510,500	510,500	483,604	510,500	550,200	440,200	510,500	511,500	511,800	523,500
13	510,500	510,500	211,639	510,500	510,500	550,200	510,500	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
14	510,500	510,500	235,377	510,500	510,500	550,200	510,500	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
15	510,500	510,500	235,377	510,500	510,500	550,200	510,500	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
16	510,500	510,500	235,377	510,500	510,500	550,200	510,500	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
17	510,500	510,500	235,377	510,500	510,500	550,200	510,500	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
18	510,500	510,500	235,377	510,500	510,500	550,200	450,389	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
19	510,500	510,500	235,377	510,500	510,500	550,200	219,894	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
20	510,500	455,711	235,377	510,500	510,500	550,200	204,440	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
21	510,500	478,747	232,497	510,500	510,500	550,200	479,798	510,500	510,500	510,500	550,200	440,200	499,960	511,500	511,800	523,500
22	510,500	510,500	235,377	510,500	510,500	550,200	510,500	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
23	510,500	510,500	235,377	510,500	510,500	550,200	510,500	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
24	510,500	510,500	235,377	510,500	510,500	550,200	510,500	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
25	510,500	510,500	235,377	510,500	510,500	550,200	510,500	510,500	510,500	510,500	550,200	440,200	510,500	511,500	511,800	523,500
Total	11,345,900	11,192,358	6,363,085	11,534,840	11,042,942	12,029,716	10,556,195	11,182,421	10,424,572	11,676,091	12,307,250	9,913,002	11,275,005	11,361,900	11,366,700	11,630,280
Avg % diff*		-1.4	-43.9	1.7	-2.7	6.0	-7.0	-1.4	-8.1	2.9	8.5	-12.6	-0.6	0.1	0.2	2.5

* Avg % diff shows an average percentage of difference from basecase

Table 12: Step Down Sensitivity Analysis Results on the Conventional Landbase

Decade	Base case	OGSI Adjustment Hemlock only	No OGSI Adjustment	Existing stand volume +10%	Existing stand volume -10%	Regen stand volume +10%	Regen stand volume -10%	95% CMAI min_harvestable age	Minimum harvest age +10 years	Minimum harvest age -10 years	Landbase +10%	Landbase -10%	Green-up Height+ 2m	Green-up Height- 2m	No Visual Zone	No Wildlife Tree Patch
1	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000
2	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	359,800	400,000	400,000	359,800	400,000	400,000	400,000	400,000
3	359,800	359,800	359,800	400,000	359,800	359,800	359,800	359,800	323,620	400,000	400,000	323,620	359,800	359,800	359,800	359,800
4	323,620	323,620	323,620	359,800	323,620	323,620	323,620	323,620	291,058	400,000	359,800	291,058	323,620	323,620	323,620	323,620
5	291,058	291,058	291,058	323,620	291,058	291,058	291,058	291,058	261,752	359,800	323,620	261,752	291,058	291,058	291,058	291,058
6	291,058	291,058	261,752	323,620	261,752	291,058	291,058	291,058	235,377	323,620	323,620	235,377	291,058	291,058	291,058	291,058
7	291,058	291,058	235,377	323,620	235,377	291,058	291,058	291,058	211,639	323,620	323,620	235,377	291,058	291,058	291,058	291,058
8	291,058	291,058	211,639	323,620	162,632	291,058	291,058	281,558	190,275	280,250	323,620	211,639	279,020	291,058	291,058	291,058
9	289,513	254,970	190,275	323,620	178,669	291,058	238,227	209,998	171,048	312,931	323,620	211,639	255,572	291,058	291,058	291,058
10	428,969	425,206	190,275	441,015	448,000	527,800	421,735	396,025	190,275	448,000	523,000	400,000	431,629	432,075	435,576	493,000
11	448,000	448,000	190,275	448,000	448,000	527,800	447,057	448,000	446,246	448,000	523,000	400,000	448,000	448,000	448,000	494,000
12	448,000	448,000	190,275	448,000	448,000	527,800	448,000	448,000	427,315	448,000	523,000	400,000	448,000	448,000	448,000	494,000
13	448,000	448,000	190,275	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
14	448,000	448,000	190,275	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
15	448,000	448,000	190,275	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
16	448,000	448,000	235,377	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
17	448,000	448,000	235,377	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
18	448,000	448,000	235,377	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
19	448,000	448,000	235,377	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
20	448,000	448,000	218,049	448,000	448,000	527,800	217,805	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
21	448,000	448,000	225,035	448,000	448,000	527,746	423,009	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	493,150
22	448,000	448,000	235,377	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
23	448,000	448,000	235,377	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
24	448,000	448,000	235,377	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
25	448,000	448,000	235,377	448,000	448,000	527,800	448,000	448,000	448,000	448,000	523,000	400,000	448,000	448,000	448,000	494,000
Total	10,086,134	10,047,828	6,141,271	10,338,915	9,780,908	11,383,456	9,771,485	9,964,175	9,332,405	10,368,221	11,545,900	8,930,262	10,042,815	10,090,785	10,094,286	10,840,860
Avg % diff*		-0.4	-39.1	2.5	-3.0	12.9	-3.1	-1.2	-7.5	2.8	14.5	-11.5	-0.4	0.0	0.1	7.5

* Avg % diff shows an average percentage of difference from basecase

Table 13: Step Down Sensitivity Analysis Results on the Constrained Conventional Landbase

Decade	Base case	No OGSI Adjustment	Existing stand volume +10%	Existing stand volume -10%	Regen stand volume +10%	Regen stand volume -10%	95% CMAI min_harvestable age	Minimum harvest age +10 years	Minimum harvest age -10 years	Landbase +10%	Landbase -10%	Green-up Height+ 2m	Green-up Height- 2m	No Visual Zone	No Wildlife Tree Patch
1	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000
2	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	359,800	400,000	400,000	400,000	400,000
3	359,800	359,800	400,000	359,800	359,800	359,800	359,800	359,800	400,000	400,000	323,620	359,800	359,800	359,800	359,800
4	323,620	323,620	359,800	323,620	323,620	323,620	323,620	323,620	359,800	359,800	291,058	323,620	323,620	323,620	323,620
5	291,058	291,058	323,620	291,058	291,058	291,058	291,058	291,058	323,620	323,620	261,752	291,058	291,058	291,058	291,058
6	291,058	261,752	323,620	261,752	291,058	291,058	261,752	291,058	323,620	323,620	235,377	291,058	291,058	291,058	291,058
7	291,058	235,377	323,620	235,377	291,058	291,058	261,752	291,058	323,620	323,620	235,377	291,058	291,058	291,058	291,058
8	291,058	211,639	323,620	140,973	291,058	285,313	261,752	247,904	284,654	323,620	211,639	264,531	291,058	291,058	291,058
9	222,112	190,275	263,619	197,767	268,563	182,386	232,520	84,909	310,237	302,711	190,275	222,360	225,196	222,112	291,058
10	424,812	190,275	424,778	427,229	455,653	382,907	356,669	40,305	448,000	469,079	400,000	426,684	424,083	425,389	452,921
11	448,000	190,275	448,000	448,000	480,000	443,479	445,843	188,611	448,000	495,100	400,000	448,000	448,967	449,052	466,000
12	448,000	190,275	448,000	448,000	480,000	448,000	448,000	423,782	448,000	495,100	400,000	448,000	449,000	449,200	466,000
13	448,000	190,275	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
14	448,000	190,275	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
15	448,000	190,275	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
16	448,000	190,275	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
17	448,000	190,275	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
18	448,000	235,377	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
19	448,000	235,377	448,000	448,000	480,000	258,652	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
20	448,000	228,011	448,000	448,000	480,000	157,012	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
21	448,000	225,558	448,000	448,000	480,000	419,510	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
22	448,000	235,377	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
23	448,000	235,377	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
24	448,000	235,377	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
25	448,000	235,377	448,000	448,000	480,000	448,000	448,000	448,000	448,000	495,100	400,000	448,000	449,000	449,200	466,000
Total	10,014,576	6,061,552	10,262,677	9,757,576	10,571,868	9,413,853	9,866,766	9,166,105	10,293,551	11,052,570	8,908,898	9,990,169	10,031,898	10,033,005	10,381,631
Avg % diff*		-39.5	2.5	-2.6	5.6	-6.0	-1.5	-9.3	2.8	10.4	-11.0	-0.2	0.2	0.2	3.7

* Avg % diff shows an average percentage of difference from basecase

Figures 19 - 22 graph the results shown in tables 11-13.

Figure 19: Comparison of Planned Management, Conventional, and Constrained Conventional Base Runs

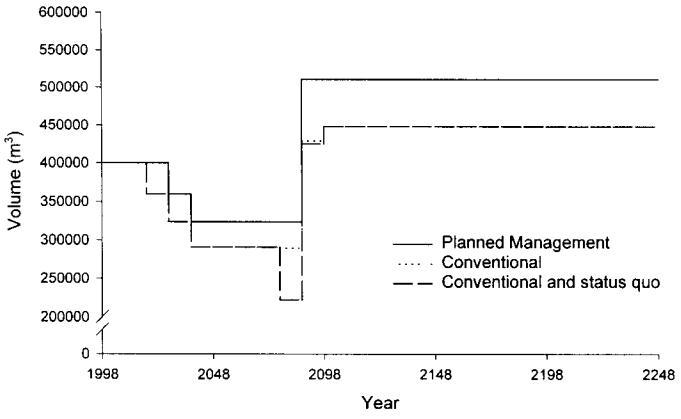


Figure 20: Planned Management; Step Down Sensitivity, Comparison of Basecase, 95% CMAI Minimum Harvestable Age, and No OGSI Adjustment

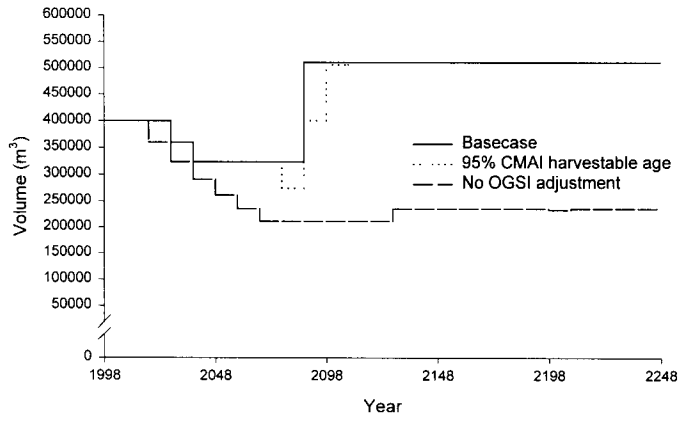


Figure 21: Conventional; Step Down Sensitivity, Comparison of Basecase, 95% CMAI Minimum Harvestable Age, and No OGSI Adjustment

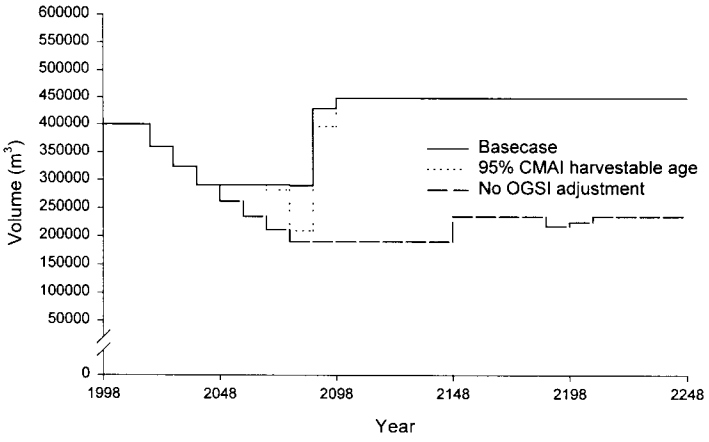
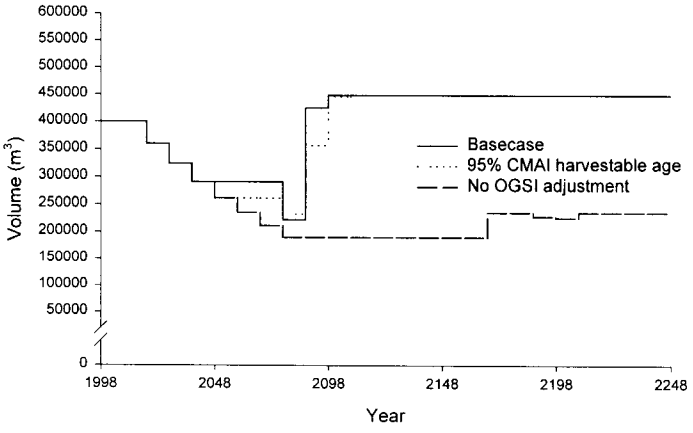


Figure 22: Constrained Conventional; Step Down Sensitivity, Comparison of Basecase, 95% CMAI Minimum Harvestable Age, and No OGSI Adjustment



ADDITIONAL RESULTS

This section displays additional results, from the timber supply analysis, planned management even flow harvest. The figures presented are:

Figure 23: Average rotation age over time.
Figure 24: Distribution of rotation ages over time.
Figure 25: Area harvested over time.
Figure 26: Volume per hectare harvested over time.

Figure 23: Average Rotation Age Over Time Harvested Average Age Per Decade in the Planned Management Landbase of TFL 41

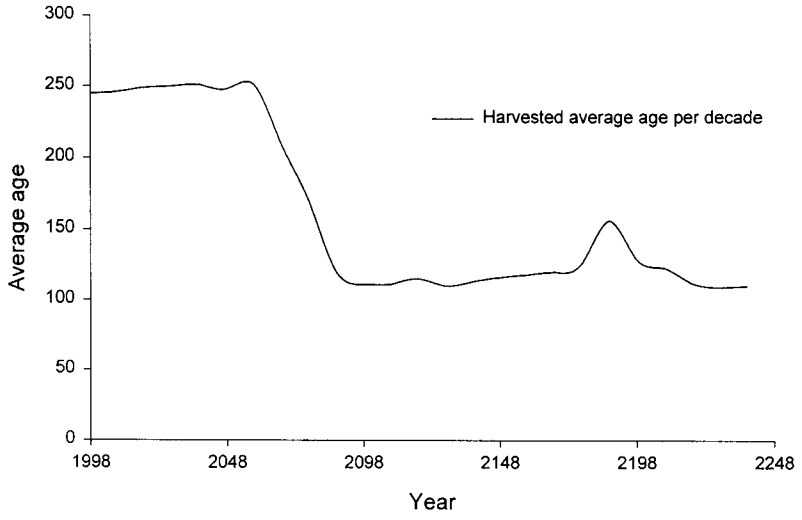
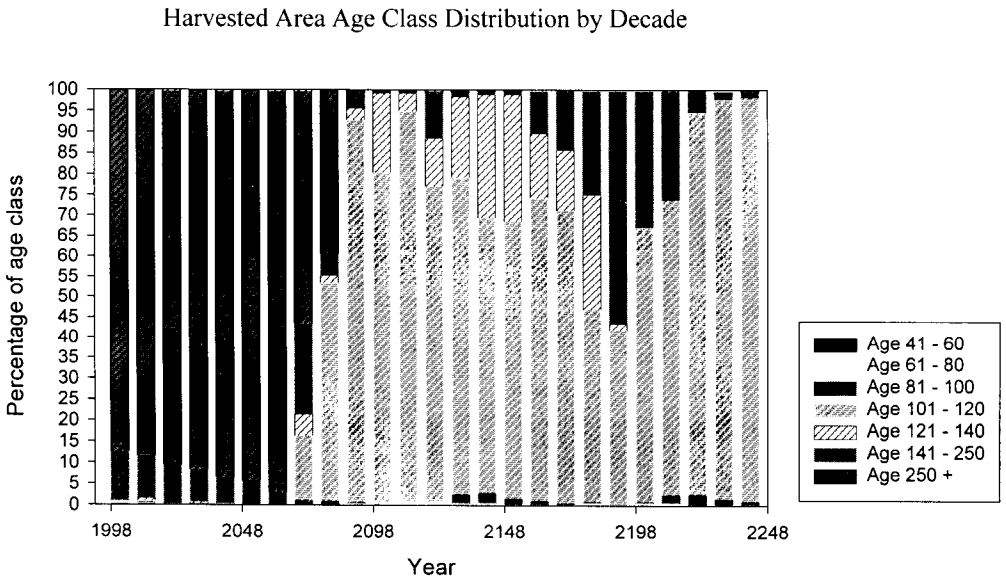


Figure 24: Distribution of Rotation Age Over Time in the Planned Management Landbase of TFL 41



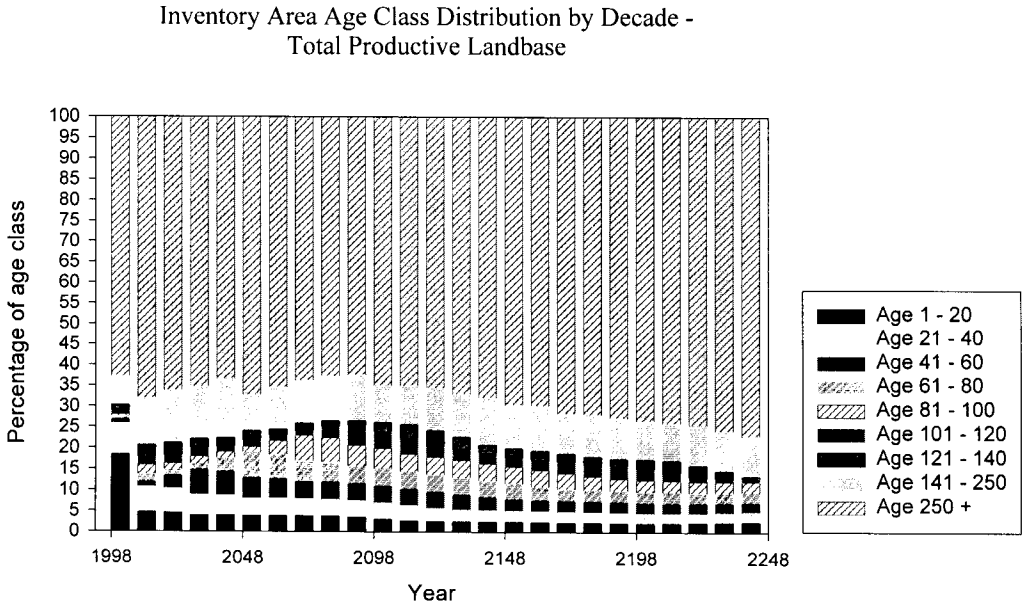


Figure 25: Planned Management; Area Harvested Over Time
Total Harvested Area Per Decade

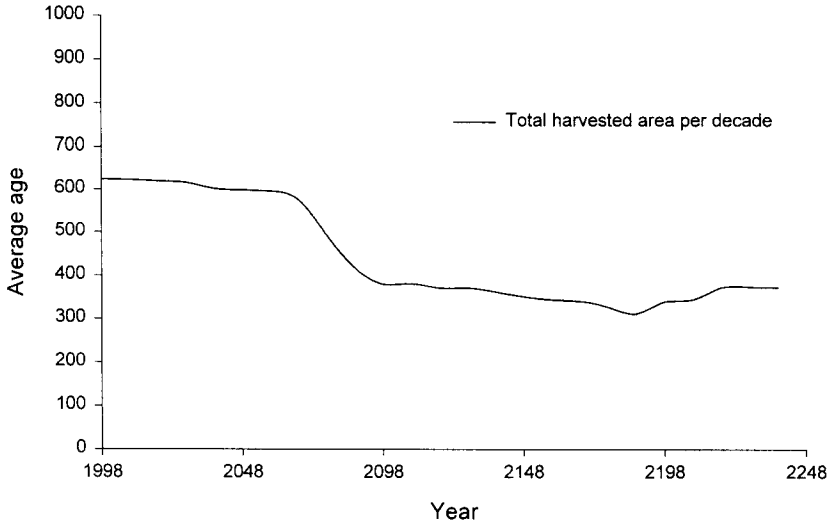
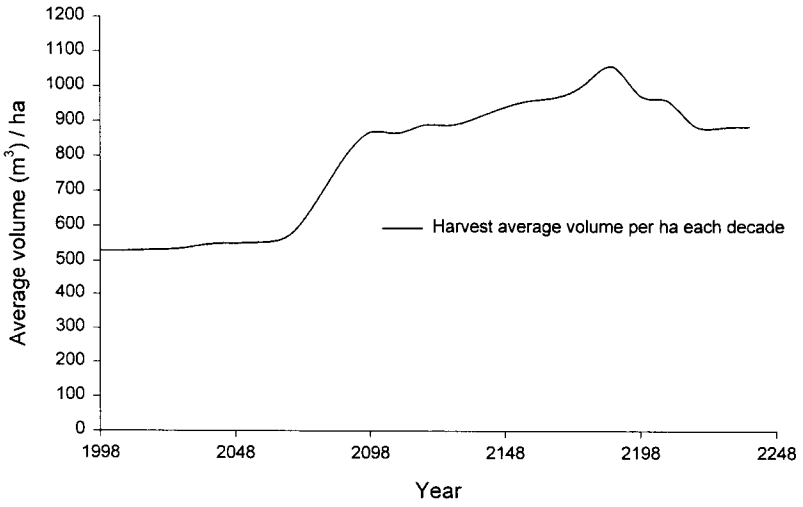


Figure 26: Planned Management; Volume Per Hectare Harvested Over Time
Harvested Average Volume Per Ha Each Decade



CONCLUSIONS

The planned management timber harvesting landbase is only 20% of the gross productive landbase. The biological potential even flow harvest from the gross productive landbase is 1.1 million cubic metres per year when no cover constraints are applied. With cover constraints, the even flow from the gross productive landbase is 543,475 cubic metres per year. The approved 20-year plan using current green-up and adjacency rules indicates about 24 years of harvest at the present allowable rate of 400,000 cubic metres per year. This agrees with the results of the timber supply analysis which shows 30 years of current harvest to be available in the planned management benchmark run.

On TFL 41, timber supplies are expected to be plentiful in the next 20 years and in the long term. Timber supplies are forecasted to be tight in the medium term. The sensitivity analyses show that medium term timber supplies can be increased by significantly shortening the minimum harvest age by ten years. Additional analysis shows that medium term harvest rates can be maintained at 400,000 cubic metres per year when the minimum harvest age is shortened by ten years and, at the same time, the timber harvesting landbase is increased by 10% (6,800 hectares).

It is recommended that the harvest rate for the next five years from TFL 41 be maintained at 400,000 cubic metres per year.

APPENDICES

APPENDIX I

TFL 41 INFORMATION PACKAGE

APPENDIX II

REPORT ON THE RE-INVENTORY OF TREE FARM LICENCE 41 1996 - 1998