MANAGEMENT PRACTICES ON PACIFIC NORTHWEST WEST-SIDE INDUSTRIAL FOREST LANDS, 1991-2005: WITH PROJECTIONS TO 2010

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Stand Management Cooperative
SILVICULTURE ▪ NUTRITION
WOOD QUALITY ▪ MODELING

STAND MANAGEMENT COOPERATIVE
SMC WORKING PAPER NUMBER 6
NOVEMBER 2007

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CHAPTER 1: INTRODUCTION

This report summarizes the sixth survey of silvicultural practices of members of the Stand Management Cooperative (SMC). Previous surveys, conducted in 1983, 1986, 1991, 1996, 2001, and 2006, collected data for the preceding 10 years and asked respondents to provide 5-year projections. Results of the first three surveys were summarized and distributed to members but no formal publications were developed, the 1996 survey was summarized in the SMC Quarterly (Briggs 1997), and the 2001 survey was published as SMC Technical Report # 2 (Briggs & Trobaugh 2001). While many of the survey questions have been the same, they have expanded in breadth and level of detail. Survey # 6, was prepared and discussed at the September 2005 meeting of the SMC Policy Committee and mailed in Spring 2006 with a follow-up mailing in Summer 2006.

In 2005/06 SMC landowner members included federal (BLM), state (Oregon Dept. of Forestry, Washington Dept. Natural Resources), county (King County Dept. Natural Resources), and tribal (Quinault Dept. Natural Resources) forest land managing agencies plus 17 private sector forest companies. The latter includes traditional integrated industrial forest companies, real-estate investment trusts (REIT's) and timber investment management organizations (TIMO's). This report combines the data provided by 9 private sector respondents to the 2001 survey (Briggs & Trobaugh 2001) with data provided by 6 private sector respondents to the 2006 survey. Data from the respondents to each survey was pooled; hence, each survey considers the data as if it were the profile of a single composite private sector entity with holdings in Western Oregon and Washington, hereafter referred to as the "west side".

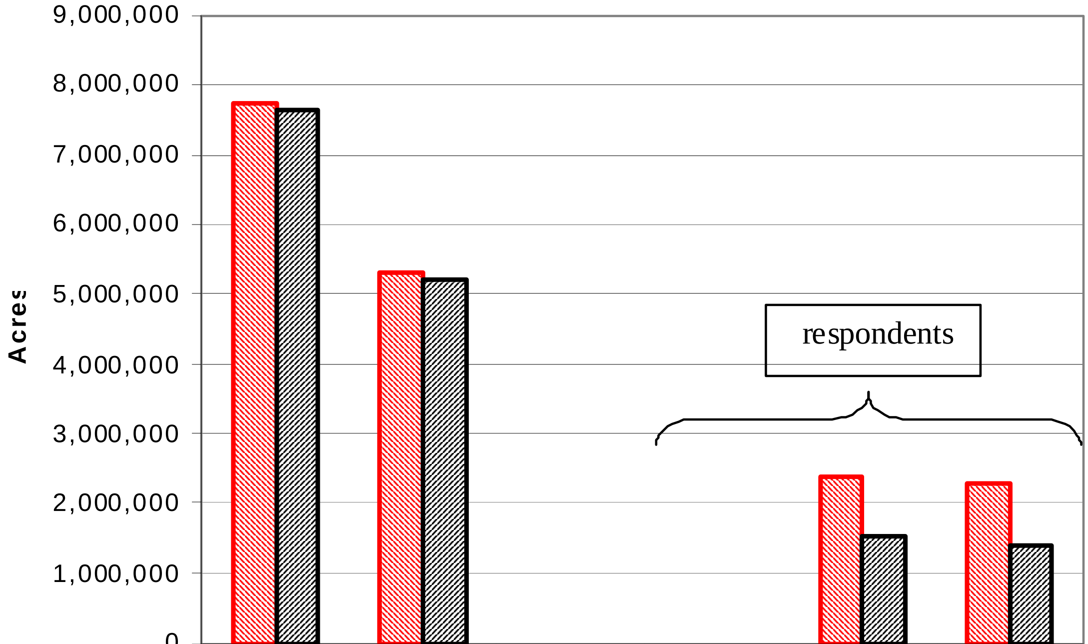
All of the time series data are presented by dividing the combined respondent total acres receiving a treatment by their total net timberland. This ratio is multiplied by 1000 to create an "intensity rate" expressed in treated acres per thousand acres (A/1000A) of total net timberland. In several questions, respondents also provided data by species; in these cases intensity rates were also expressed in A/1000A of net timberland for that species. The acreage of net timberland by species was derived from responses to Questions 1 and 2. Occasionally a respondent provided an overall treatment total with no species detail. Consequently, the sum of the species-level intensities may not coincide with the intensity calculated for the overall total. For questions where means and standard errors are presented, the statistics were not weighted by respondent size. Due to the small sample size and wide range of values reported by the respondents, standard errors are quite large and statistical tests would not reveal statistically significant differences.

Chapter 2 of this report describes the sampling frame, response rate, and general characteristics of the respondents. Chapter 3 presents harvest unit size and rotation length information and Chapter 4 presents costs associated with silvicultural activities. Chapters 5-11 respectively summarize trends in site preparation, regeneration, vegetation management, thinning, fertilization, and pruning. Chapter 12 summarizes respondent issues with pest management and Chapter 13 summarizes responses to questions related to the current regulatory situation. The 2006 survey questionnaire is provided in the Appendix.

CHAPTER 2: RESPONSE RATE & REPSONDENT CHARACTERISTICS

Figure 2.1 and Table 2.1 present information on the acreage owned by the west-side private industry, the portion owned by SMC private industry members, and that of the respondents.

Figure 2.1 Comparison of west side and respondent acreage status 2000 and 2005.



	Region gross	SMC gross	SMC # mbrs	SMC # resp	Resp Gross	Resp Net
2000	7,767,000	5,317,423	17	9	2,404,715	2,274,300
2005	7,663,000	5,214,375	16	6	1,540,837	1,414,255

Table 2.1 Survey Representation of Industrial Timberland in Western Oregon and Washington

	2000	2005
SMC % of gross West side industrial timberland	68%	68%
Average respondent, acres timberland	267191	256806
Respondents % of SMC land	45%	30%
Respondents % of West side industrial timberland	31%	20%
# Respondents, % of # SMC industrial landowners	53%	38%

In 2000 the SMC private industry members owned 5.317 million acres of timberland[1] on the west-side which declined slightly to 5.214 million acres in 2005. Timberland acreage includes unproductive areas, roads, riparian buffers, etc. Forest inventory statistics available for the 2001 survey indicated that private industry owned 4.035 million acres of timberland in western Oregon (MacLean 1990) and 3.732 million acres in western Washington (Bolsinger et al. 1997); a combined total of 7.767 million acres. More recent forest inventory statistics indicate that private industry owned 4.177 million acres of timberland in western Oregon (Campbell et al. 2004) and 3,486 million acres in western Washington (Gray et al. 2005); a combined total of 7.663 million acres. The SMC forest industry members owned 68% of the west-side industrial lands in both surveys (Table 2.1)

In 2000, nine of the 17 forest industry members (53%) with 2.404 million acres of gross timberland acres responded to the survey. These respondents represented 45% of the SMC industry acreage and 31% of the total industry west-side gross timberland. The average respondent size was 267,000 acres; three owned less than 150,000 acres, three owned between 150,000 and 300,000 acres, and three owned more than 300,000 acres.

In 2005 six of the 16 forest industry members (38%) with 1.541 million acres of gross timberland responded to the survey. They represented 30% of the SMC industry acreage and 20% of the total industry west-side gross timberland. The average respondent was 257,000 acres; about 96% the size of the average 2000 respondent. Three owned less than 150,000 acres, one owned between 150,000 and 300,000 acres, and two owned more than 300,000 acres.

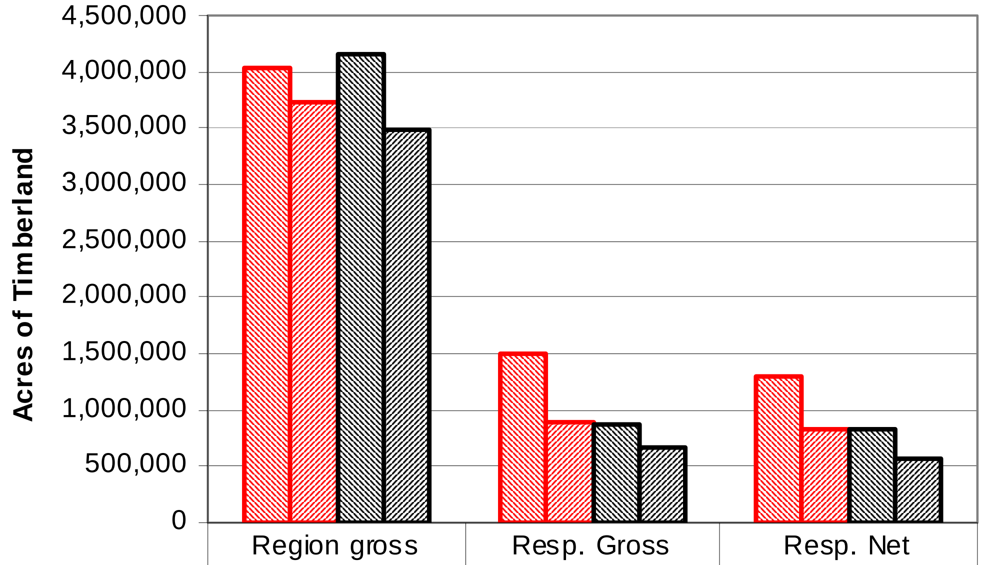
Figure 2.1 shows that the 2.405 million gross timberland acres of the respondents dropped by 5.4% in 2000 leaving net timberland of 2.274 million acres. In 2005 the drop was 8.2%; from 1.540 to 1.414 million acres. The reduction from gross to net timberland reflects reflect land occupied by rock outcrops, wetlands, and otherwise incapable of producing at least 20 cubic feet per acre per year. This net timberland acreage is the basis for calculating management intensity statistics in later chapters. The further reduction of net timberland associated with roads and other infrastructure and with constraints on use due to regulations and other factors is discussed in Chapter 12.

Figure 2.2 presents acreage data at the state level. There has been a shift toward more industrial timberland in Oregon from 52 to 55% of the west-side total. This may reflect greater shifts of industrial timberland in Washington to development and other non-industrial owners. There is relatively more respondent gross timberland (63% in 2000 and 57% in 2005) in Oregon. Similarly, relatively more respondent net timberland (61% in 2000 and 60% in 2005) is in Oregon. The shift between gross and net timberland may reflect differences between the states in timberland that is in infrastructure, subject to regulations, etc. (see Ch 13). To the extent that there are differences in management practices and forest practice regulations between the states, the survey may be somewhat biased toward Oregon conditions. In 2000, net timberland of respondents was 86%of their gross timberland in Oregon while the corresponding figure in Washington

[1] Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute of administrative regulation. (Note: Areas qualifying as timberland are capable of producing in excess of 20 cubic feet per acre of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.) (Smith et al. 2004)

was 93%. In 2005, the corresponding ratios of net to gross timberland were 96% in Oregon and 86% in Washington. Reasons for this reversal between the two states are unclear and may simply reflect differences between the 2001 and 2006 respondents. With the exception of the response rate in terms of percent of members, the average respondent size and distribution of acreage of the two surveys are similar.

Figure 2.2 Total Private Industry and Respondent Timberland Acreage by State

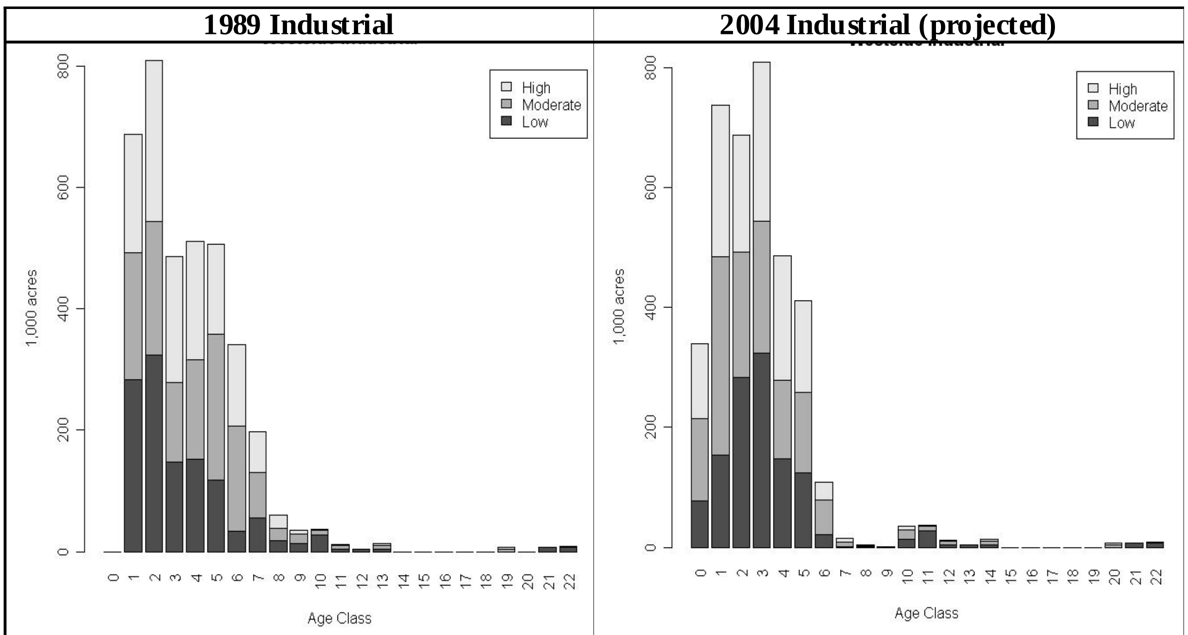


	Region gross	Resp. Gross	Resp. Net
Oregon 2000	4,035,000	1,507,909	1,301,896
Wash 2000	3,732,000	896,806	832,674
Oregon 2005	4,177,000	878,356	846,381
Wash 2005	3,486,000	662,481	567,874

2.1 Age Class Distributions

A factor that may affect interpretation of trends in silvicultural practices and other results is the changing distribution of age classes on industrial timberlands. Figure 2.3 presents the age class distribution industry timberland in western Washington in 1989 and 2004 (Lippke et al. 2007). The acres reported for a specific cultural practice depend on the number of acres that have reached the appropriate stage of development when the practice would be applied. Figure 2.3 indicates compression of the age class distribution between 1989 and 2004 with fewer acres remaining in age classes beyond 50 years, the prevalent rotation age (Briggs & Trobaugh 2001). The shifting of age class cohorts may alter the need for certain silvicultural practices. For example, the age 10-19 year old cohort in 1987 reflects stands that were planted in the late 1960's through the mid-1970's with the site preparation, planting spacing, competing vegetation control, and future rotation age assumptions of that era. The need for, and timing of, thinning, fertilization and other silviculture of this cohort was different than that for the same age cohort that existed in 2004 that was planted with 1990's site preparation, planting spacing, and competing vegetation control practices and rotation age assumptions. The effect of aging cohorts of stands on intensity of cultural practices is similar to the effect of the "baby-boom" segment of the US population on social trends. The movement of acres through stand development age classes, their silviculture needs, and economic conditions during the survey period must be kept in mind when interpreting the results.

Figure 2.3 Age Class Distribution of Western Washington Industrial Timberland, 1989 vs 2004, Stratified by High (>125), Moderate (105-125), and Low (<105) Site King's Site Index (Lippke et al. 2007)

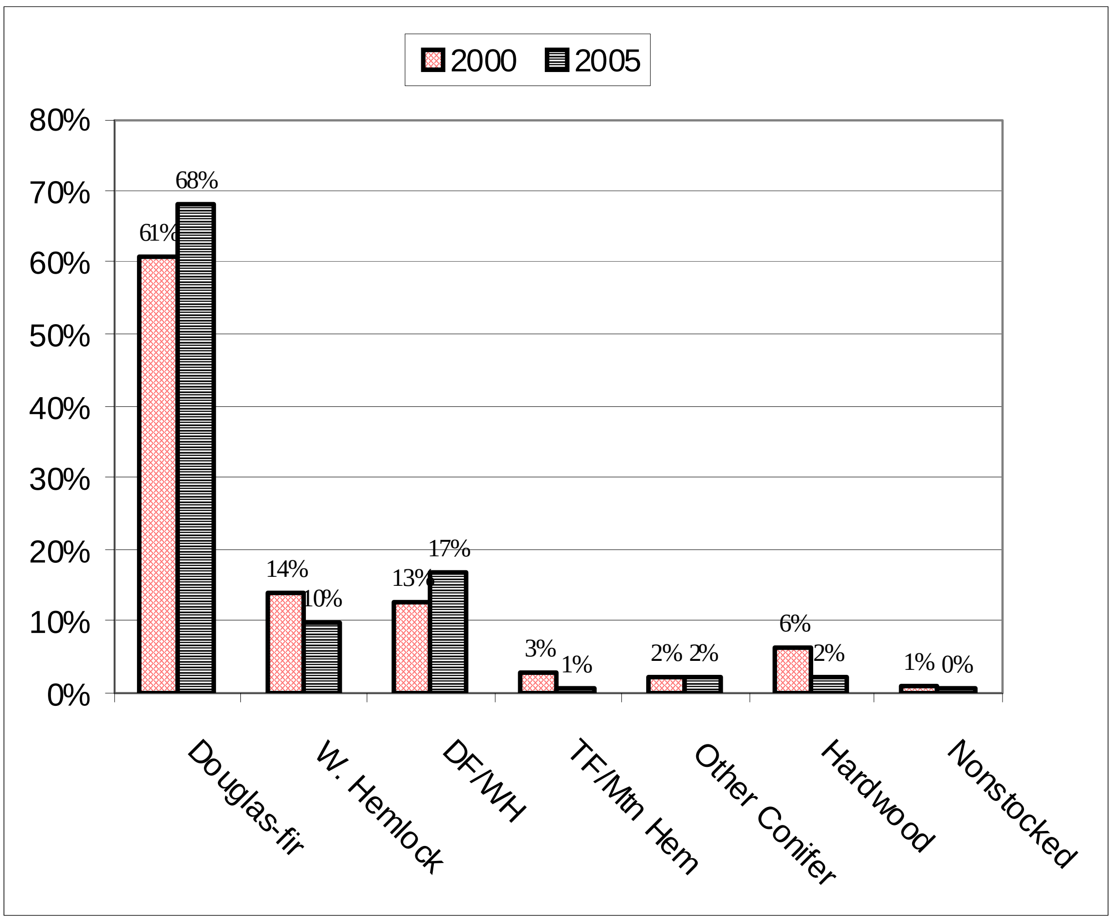


Notes: Age classes are 10-year classes with class 1 being 0-9 years, 2 = 10-19, etc. The 0 class is essentially areas that were "cut but not planted" to take up the slack when updating decadal age classes 15 years. The data for 1989 are acreage data from the USFS Forest Inventory and Analysis. To obtain the age class distribution for 2004, age classes were harvested under the assumptions that (1) harvest volume approximated the volume reported in the DNR timber harvest reports, (2) all acreage > 80 years was off limits and assumed to be reserved, (3) riparian acreage based on the DNR hydro layer was reserved based on the forest practices rules in force during each 5-year update period, and (4) the only harvest regime applied was clearcutting

2.2 Net Timberland by Forest Type

The surveys obtained the percentage breakdown of respondent net timberlands by species cover type. The percentages reported by each respondent were applied to that respondents' total net timberland acreage and the results were summed across respondents to obtain composite totals. Douglas-fir, hemlock, and a Douglas-fir/hemlock mix accounted for 88% of the net timberland of the 2001 survey respondents (Figure 2.4). The distribution of net timberland of the 2005 respondents is more strongly concentrated (95%) in Douglas-fir, western hemlock and mixtures of these species.

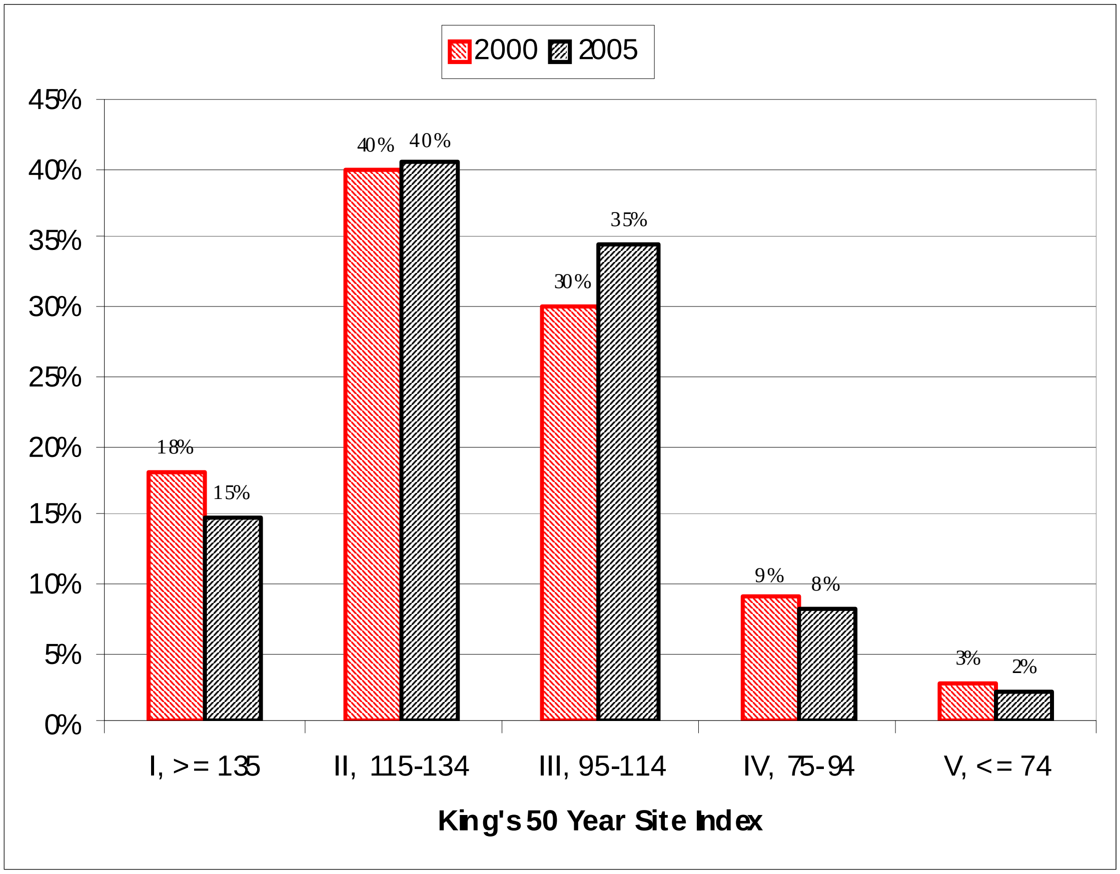
Figure 2.4 Net Timberland by Forest Type



2.2 Acreage by Site Index

The survey also obtained the percentage breakdown of respondent net timberlands by King's (1966) 50 year basis site index. The percentages reported by each respondent were applied to that respondents' total net timberland and the results were summed across respondents to obtain composite owner totals. The overall distribution between the two surveys is very similar Figure 2.5); 90% in site classes I-III in 2000 and 88% in 2005. There has been a small shift toward more site class I and less site class III from 2000 to 2005.

Figure 2.5 Net Timberland by Site Index (King 1966)

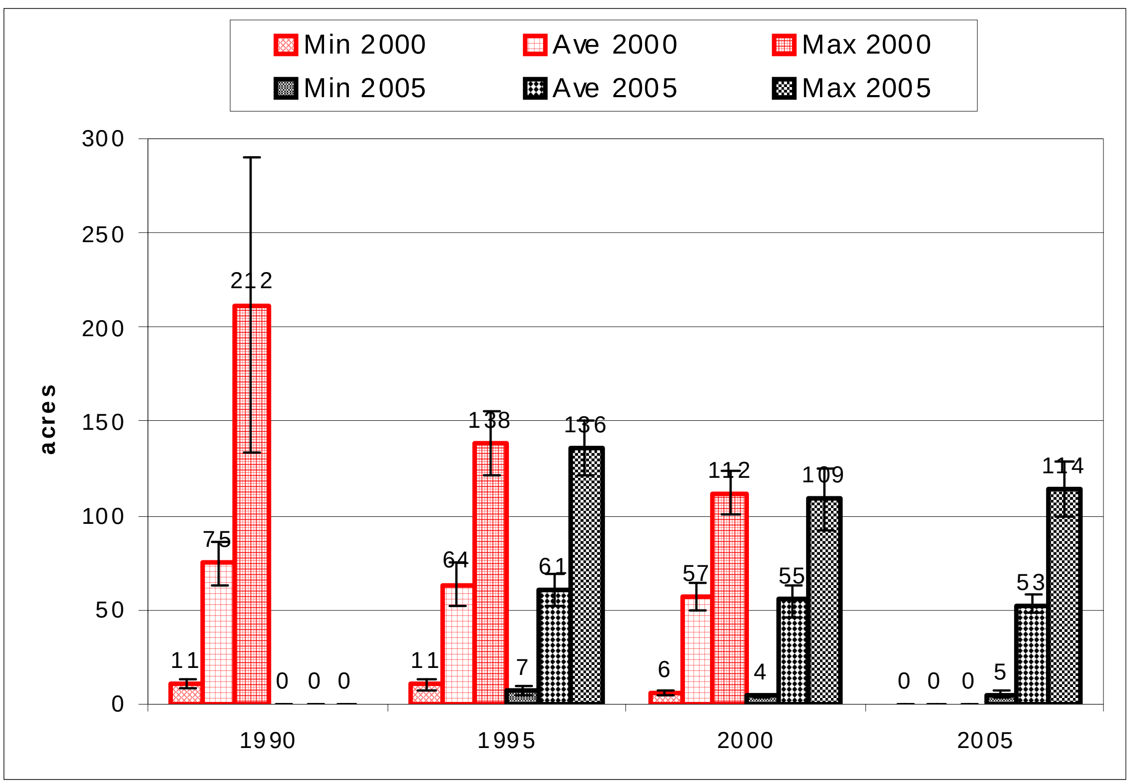


CHAPTER 3: HARVEST UNIT SIZE & ROTATION LENGTH

3.1 Harvest Unit Size

The 2001 survey asked respondents to indicate the minimum, maximum, and average size harvest unit in 1990, 1995, and 2000. The 2006 survey obtained this information for 1995, 2000, and 2005. The means and standard errors of the reported values are presented in Figure 3.1. A trend toward smaller harvest units is clearly evident; the average unit has dropped from 75 to about 55 acres from 1990 to 2000 with essentially no subsequent change. The maximum size harvest unit declined from 212 to 112 acres, or almost half, from 1990 to 2000 with little change thereafter. The standard errors have also decreased over time suggesting that differences between organizations have narrowed. Results from respondents to the 2001 and 2006 surveys overlap for the years 1995 and 2000 and show only slight differences.

Figure 3.1 Minimum, Average, and Maximum Harvest Unit Size, Acres, Reported in the 2000 and 2005 Surveys (±se)



3.2 Harvest Practices

The surveys asked respondents to indicate the average annual percentage of the area harvested that received one of the treatments or activities listed in Table 3.1 and to indicate their expectations for the next 5 years. 2001 respondents indicated that they conducted whole tree logging on 21% of their harvest units while the 2006 respondents indicated that this rose to 36%. In contrast, yarding unmerchantable material declined from 12% to 0.3%. Maintenance or creation of wood material and snags changed little (50% vs 46%), green tree retention increased (17% vs 26%), and species conversion changed little (14% vs 17%). With the exception of an increase in whole tree logging, 2006 respondents expect recent levels to continue in the next 5 years.

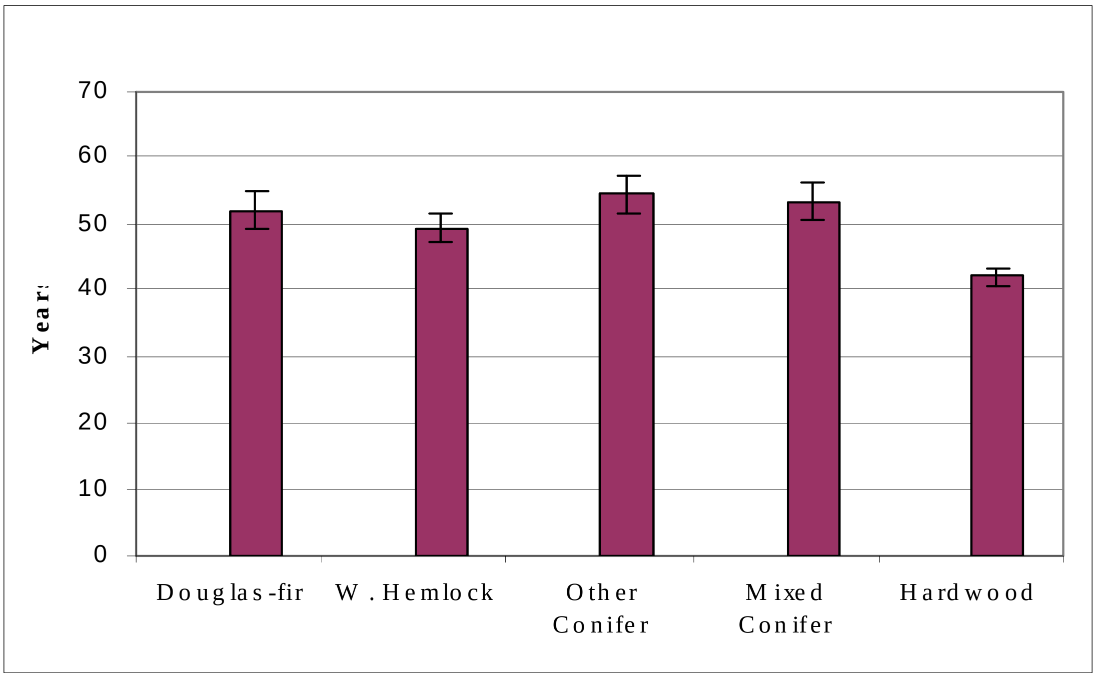
Table 3.1 Harvest area treatments, %

2001 Respondents				
	Harvest Area Treatment	**Mean**	**Std Error**	**No. Responses**
1996-2000				
	Whole tree logging	21%	6.2	8
	Yard unmerchantable material	12%	10.5	9
	Maintain or create woody material & snags	50%	16.0	9
	Green tree retention	17%	12.0	8
	Species conversion	14%	4.2	8
2001-2005 projection				
	Whole tree logging	24%	6.7	8
	Yard unmerchantable material	12%	10.5	9
	Maintain or create woody material & snags	55%	14.7	9
	Green tree retention	17%	12.0	8
	Species conversion	15%	6.7	8
2006 Respondents				
	Harvest Area Treatment	**Mean**	**Std Error**	**No. Responses**
2001-2005				
	Whole tree logging	36%	13.6	6
	Yard unmerchantable material	0.3%	0.3	4
	Maintain or create woody material & snags	46%	22.3	5
	Green tree retention	26%	24.6	4
	Species conversion	17%	9.2	6
2006-2010 projection				
	Whole tree logging	45%	14.0	6
	Yard unmerchantable material	0.3%	0.3	4
	Maintain or create woody material & snags	47%	21.5	5
	Green tree retention	27%	24.4	4
	Species conversion	17%	10.1	6

3.3 Rotation Age

The 2001 survey asked respondents to indicate current rotation age by species. The means and standard errors of the reported values are presented in Figure 3.2. In 2000, the average rotation age for Douglas-fir and hemlock was approximately 50 years with somewhat longer rotations for mixed conifers and other conifers. The average rotation for hardwoods, primarily red alder, was approximately 40 years. Since most of the land owned by the 2001 respondents was in site classes I-III (Figure 2.5) it is reasonable to assume that these are averages for these site classes.

Figure 3.2. Rotation age by Species: 2001 Survey, (±se)



In the 2006 survey, respondents were asked to provide rotation age by site class for each species. Figure 3.3 shows decreasing rotations as site class increases. Since most of the land owned by forest industry is site class 3 and higher (Figure 2.5), the rotation age is generally under 50 years on most industrial forest land for conifers, especially on site classes I and II. The pattern for alder is similar with lower rotations on higher site classes; the higher site class alder stands are being managed on rotations less than 40 years. Comparison of the two surveys suggests a general shortening of rotation lengths.

The surveys also asked respondents to indicate if certain cultural treatments would increase, decrease or not change rotation length. Table 3.2 shows that 2006 respondents have a stronger belief that wide planting spacing does not change the rotation. Most respondents to both surveys indicate that pruning does not change the rotation while fertilization and other practices (pre-commercial thinning and early weed control) decrease the rotation.

Figure 3.3 Rotation age by Species and Site Class: 2006 Survey, (±se)

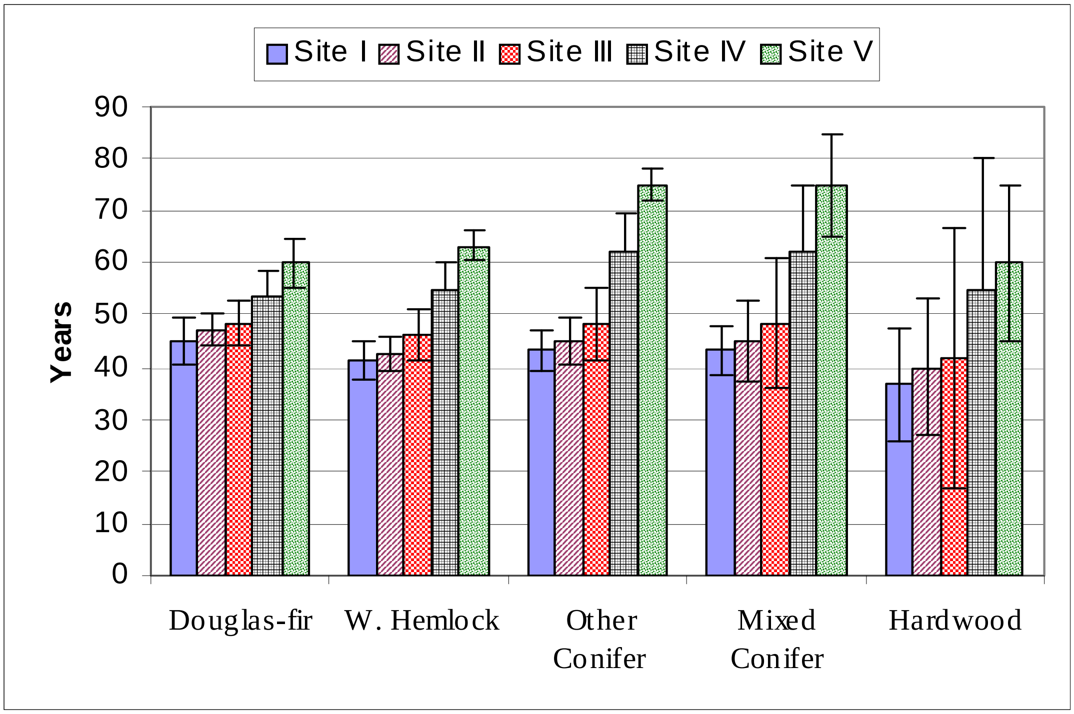


Table 3.2 Effect of Silvicultural Treatments on Rotation Length

2001 Respondents				
Treatment	**No. Responses**	**No Change in Rotation**	**Increases Rotation**	**Decreases Rotation**
Wide planting spacing	9	56%	22%	22%
Pruning	7	71%	14%	14%
Fertilization	9	22%	11%	67%
Other (pct, early weed control)	2	0	0	100%
2001 Respondents				
Treatment	**No. Responses**	**No Change in Rotation**	**Increases Rotation**	**Decreases Rotation**
Wide planting spacing	6	83%	17%	0%
Pruning	4	75%	25%	0%
Fertilization	6	33%	0%	67%
Other (pct, early weed control, genetics)	2	0	0	100%

CHAPTER 4: COSTS OF SILVICULTURAL PRACTICES

The surveys asked respondents to provide the minimum, maximum, and average cost for the silvicultural practices listed in Table 3.1 which shows the means and standard errors. For some practices, fewer than the total number of respondents provided data. The small sample size, combined with the large differences in the minimum, maximum and average costs reported by respondents, accounts for the large standard errors.

For site preparation, the average cost per acre declined noticeably for chemical site preparation and there seems to be a narrower differential between the minimum and maximum values reported in 2005 as compared to 2000. Average cost per acre for pile and burn remain unchanged while average cost for broadcast burning decreased slightly. Other site preparation methods included mechanical, burning at landings, etc.

Planting costs per acre, which were not obtained by the 2001 survey, do not include the cost of seedlings; hence, the cost of using a particular seedling stock type must be added to obtain the total cost per acre of a planting. Respondents only provided data for 9x9, 10x10, and 11x11 spacings.

Cost per acre of vegetation control do not appear to have changed much between 2000 and 2005 while cost per acre of pre-commercial and commercial thinning, fertilization, and pruning have increased.

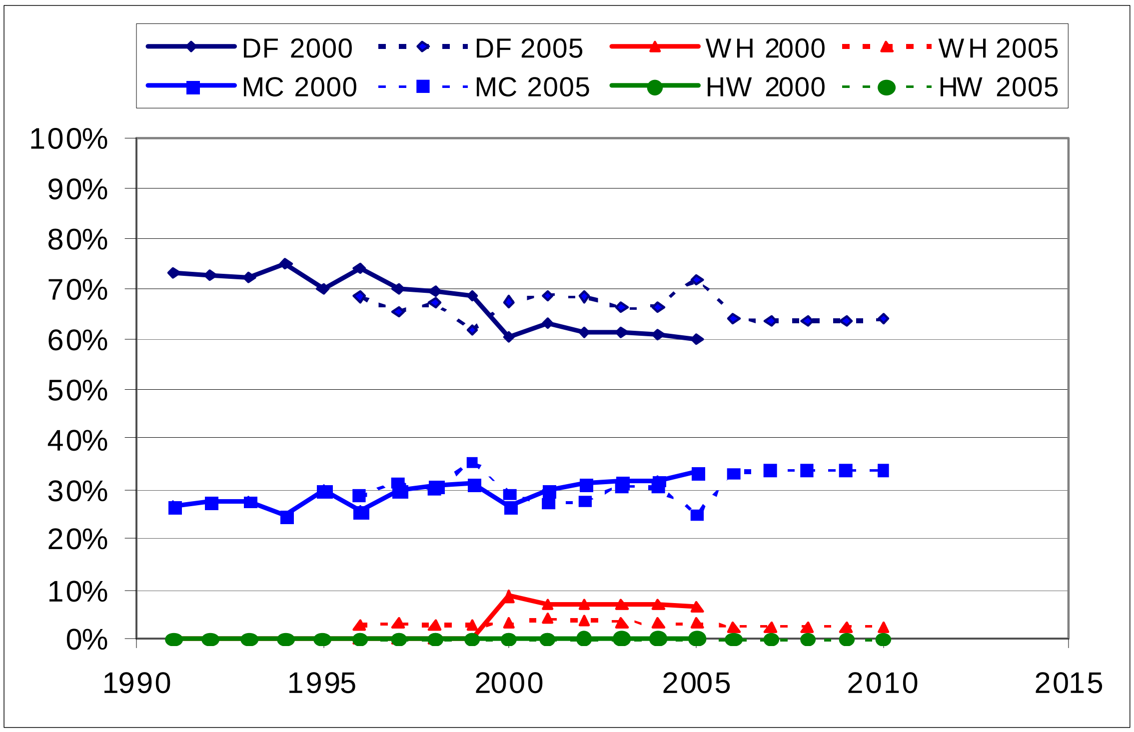
Table 4.1 Minimum, Average, and Maximum Costs for Silvicultural Practices: 2000 and 2005. All costs are per acre except as noted.

	2000 Survey						2005 Survey					
	Minimum		**Average**		Maximum		Minimum		**Average**		Maximum	
	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Site Preparation												
Broadcast Burn	$ 120	$ 42	$ 217	$ 60	$ 330	$ 119	$ 162	$ 148	$ 205	$ 105	$ 230	$ 80
Pile & burn	$ 106	$ 20	$ 140	$ 26	$ 241	$ 45	$ 127	$ 32	$ 140	$ 38	$ 178	$ 15
Chemical	$ 63	$ 10	$ 82	$ 6	$ 108	$ 10	$ 56	$ 3	$ 69	$ 5	$ 83	$ 11
Other	$ -	$ -	$ -	$ -	$ -	$ -	$ 127	$ 124	$ 140	$ 135	$ 149	$ 142
Planting												
6x6 1210 tpa												
8x8 680 tpa												
9x9 540 tpa							$138	$32	$148	$37	$168	$39
10x10 440 tpa							$78	$6	$98	$14	$118	$14
11x11 360 tpa							$70	$0	$90	$0	$105	$5
12x12 300 tpa												
15x15 200 tpa												
21x21 100 tpa												
Vegetation Control												
year 1 herbaceous	$47	$2	$61	$3	$77	$5	$30	$10	$54	$3	$72	$4
year 2 herbaceous	$46	$2	$56	$2	$75	$4	$29	$9	$57	$10	$75	$2
woody release	$29	$4	$53	$7	$100	$15	$28	$5	$56	$8	$95	$12
other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Thinning												
pre-commercial	$62	$4	$96	$3	$167	$15	$81	$13	$104	$14	$152	$23
commercial	$793	$169	$950	$172	$1,100	$195	$900	$300	$1,138	$463	$1,875	$1,125
Fertilization												
	$59	$2	$64	$2	$69	$3	$88	$10	$97	$8	$98	$12
Pruning												
per acre	$279	$79	$308	$51	$350	$100	$225	$125	$363	$63	$520	NA
per tree	$1.95	$0.05	$2.04	$0.19	$2.45	$0.05	$2.20	NA	$2.70	$0.30	$2.60	NA

CHAPTER 5: SITE PREPARATION

Figure 5.1 shows that site preparation has been predominantly conducted on Douglas-fir timberland although it has declined from more that 70% to about 65%. Site preparation of mixed conifers has risen slightly, accounting for about 30% of the site preparation and hemlock and hardwoods account for about 5%. No site preparation was reported for other conifers for either survey. In general, there is good agreement between the 2001 and 2006 surveys.

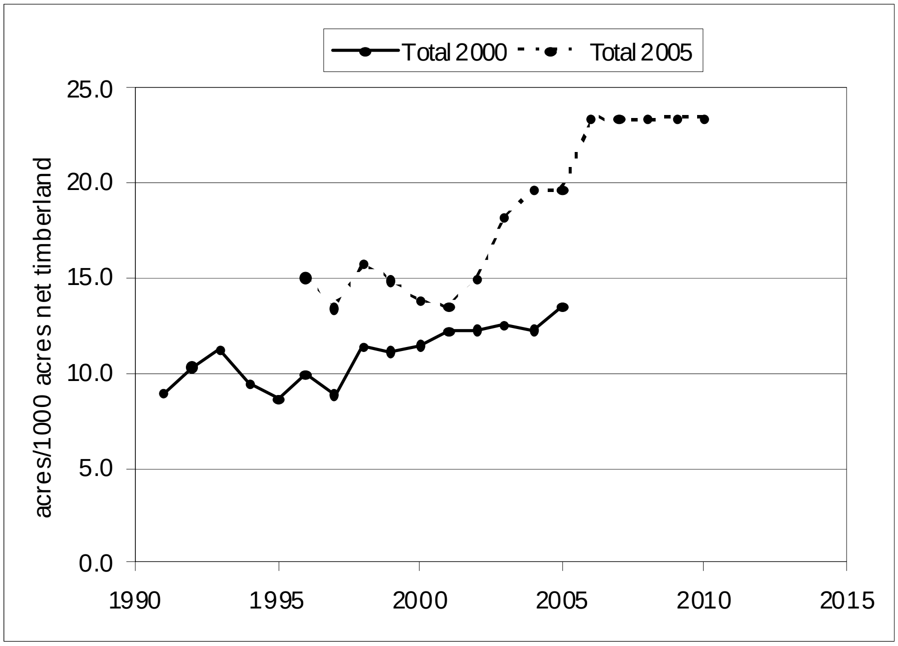
Figure 5.1 Site Preparation Trends for the 2001 and 2005 Surveys, Percent by Species. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), hardwood (HW)



5.1 Site Preparation Intensity Trends per 1000 Acres of Net Timberland

Figure 5.2 presents trends in site preparation activity per 1000 A of net timberland for the 2001 and 2006 surveys. Since some respondents only provided totals without species breakdowns, the species composition values may not sum exactly to the overall totals. The last five points in each survey series reflect projections made by respondents at the time.

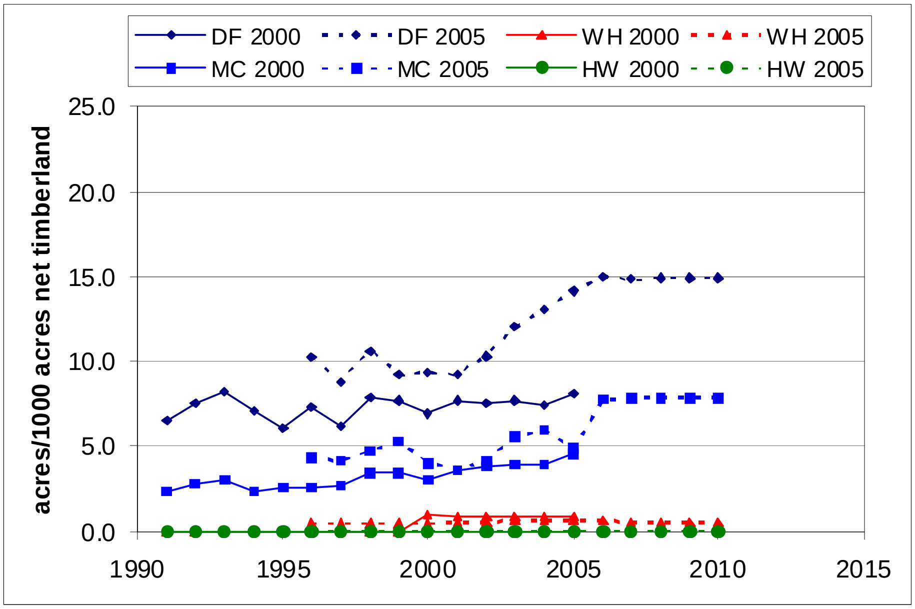
Figure 5.2 Site Preparation Trends for the 2001 and 2005 Surveys, Acres/1000 Acres Net Timberland



2001 survey respondents reported that site preparation was about 10A/1000A of net timberland in 1990-95, rose slowly to about 12A/1000A of net timberland by 2000 and was projected to continue to slowly increase. In contrast, the 2006 survey respondents indicated a higher level of site preparation over 1995-2000 (13-16A/1000A), increased the intensity to about 20A/1000A in 2004-2005 and projected it to rise slowly to about 23-24A/1000A of net timberland in the next five years.

Figure 5..3 details the Figure 5.2 site preparation intensities on total net timberland by species. Site preparation of Douglas-fir was approximately 7A/1000A since 1990 for the 2001 respondents who projected negligible change in the future. The 2006 respondents reported a higher but similarly flat trend for 1995-2000 with growth through 2005 to about 15A/1000A with little change expected in the future. Mixed conifer site preparation has steadily increased from less than 3A/1000A to about 5A/1000A and is expected to continue to rise to about 8A/1000A. Hemlock site preparation rose from zero to about 1A/1000A and is expected to remain at this level. Hardwood site preparation is just beginning to appear. None of the respondents to either survey reported any acreage of site preparation for other conifers.

Figure 5.3 Site Preparation Trends for the 2001 and 2005 Surveys, Acres/1000 Acres Net Timberland. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), hardwood (HW)



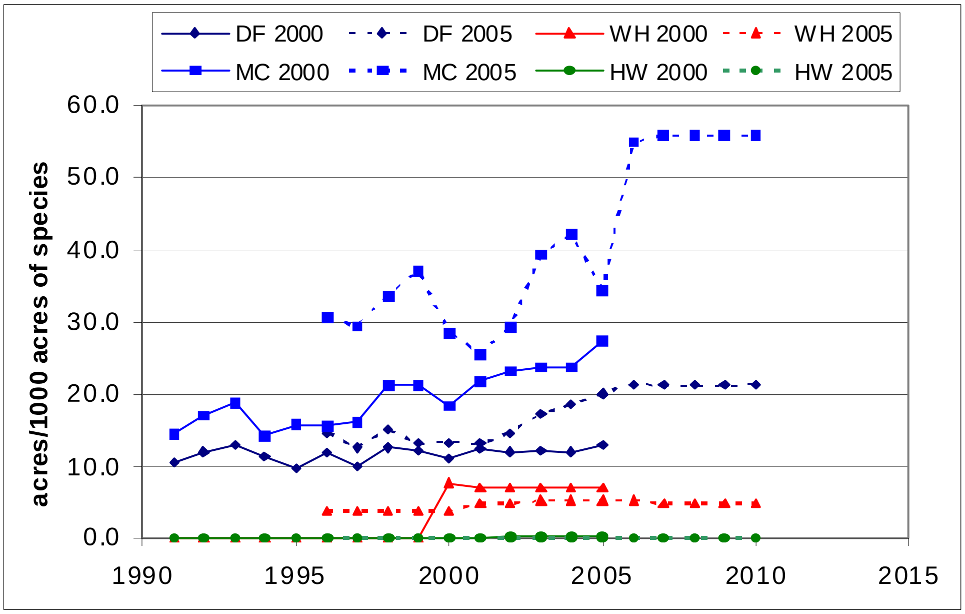
5.2 Site Preparation Intensity Trends per 1000 Acres of Net Timberland of Each Species Type

Figure 5.4 provides a different perspective by expressing acres of site preparation of each species per 1000A of net timberland of that species. The 2001 survey respondents reported site preparation on Douglas-fir land of about 12A/1000A and did not expect an increase. However, the 2006 survey respondents reported that site preparation of Douglas-fir land increased to 20A/1000A and will be slightly higher in the future.

Site preparation intensity on mixed conifer land exceeded that of Douglas-fir and has been steadily increasing. During 1995-2000, the 2006 respondents reported a higher intensity of mixed conifer site preparation (about 30A/1000A) than the 2001 respondents. Their intensity rose faster over 2001-2005 than was forecast by the 2001 respondents and they project that it will reach 55A/1000A in the future.

Site preparation on hemlock land has reached a level of about 5-7A/1000A and site preparation intensity on hardwood lands is about 0.5 A/1000A.

Figure 5.4 Site Preparation for the 2001 and 2005 Surveys, Acres/1000 Acres of Species Net Timberland. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), hardwood (HW)



5.3 Site Preparation Methods

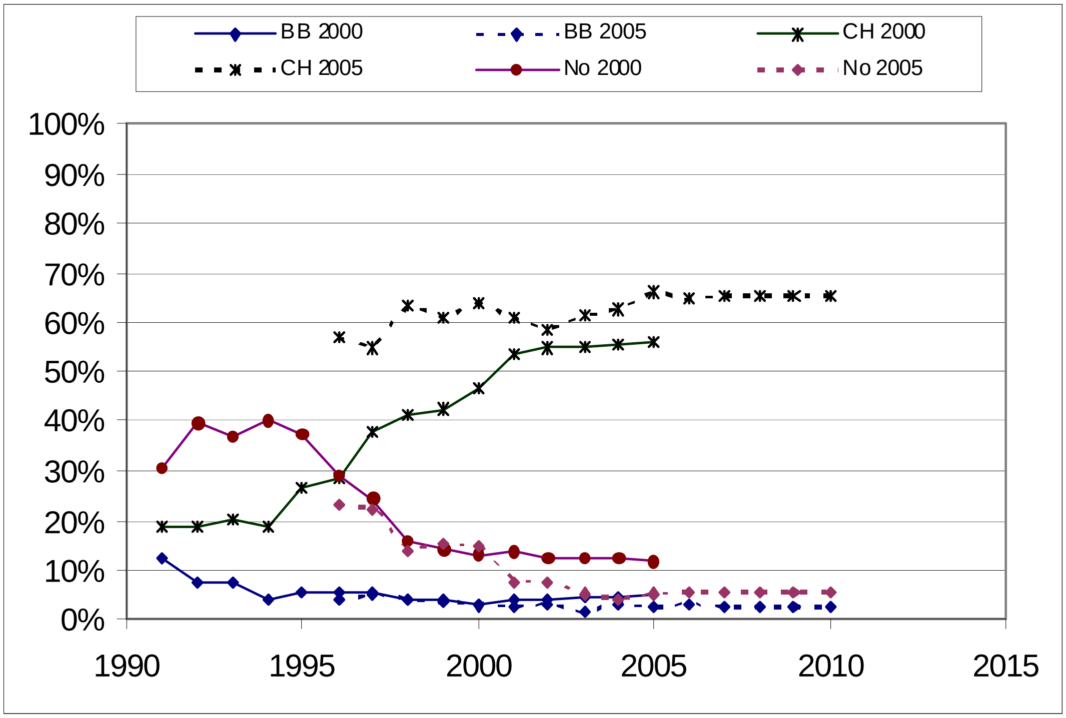
Figure 5.5 shows that no site preparation has dropped from 30-40% to about 10% or less. Mechanical and broadcast burn methods of site preparation have steadily dropped to around 5% each while pile and burn has remained steady at about 20%. Use of chemicals for site preparation has grown from about 20% to 60%

Figure 5.6 summarizes trends in methods of site preparation. The 2001 respondents reported a total intensity of 18-20A/1000A of net timberlands and they expected that this would not change. During 1995-2000, the 2006 respondents total site preparation similar to the 2001 respondents. However, the 2006 respondent level increased from 18-20 A/1000A to 26-27A/1000A, a level they expect will continue in the future. No site preparation declined from about 8A/1000A to 2A/1000A.

The growth in site preparation can be attributed to chemical treatments which have grown from about 3A/1000A in 1990 to about 18A/1000A. The 2006 respondents indicate a higher level of chemical site preparation use during the 1995-2000 overlap period with the 2001 respondents, had a higher rate of adoption over 2001-2005 than was forecast by the 2001 respondents, and expect the chemical site preparation intensity will be about 27A/1000A in the future. Among the chemical methods, use of pre-emergent herbicides has grown from less than 50% prior to 1996 to 70-90% recently and is expected to rise to 95% in the future (Figure 5.7).

Pile & burn site preparation has risen from about 3A/100A to about 7A/1000A. Mechanical site preparation declined from about 3A/1000A to less than 1A/1000A and broadcast burn has declined from 2 to about 1A/1000A.

Figure 5.5 Site Preparation Trends for the 2001 and 2005 Surveys, Percent by Method. No site preparation (No), Broadcast burn (BB), pile & burn (PB), mechanical (MC), chemical (CH)



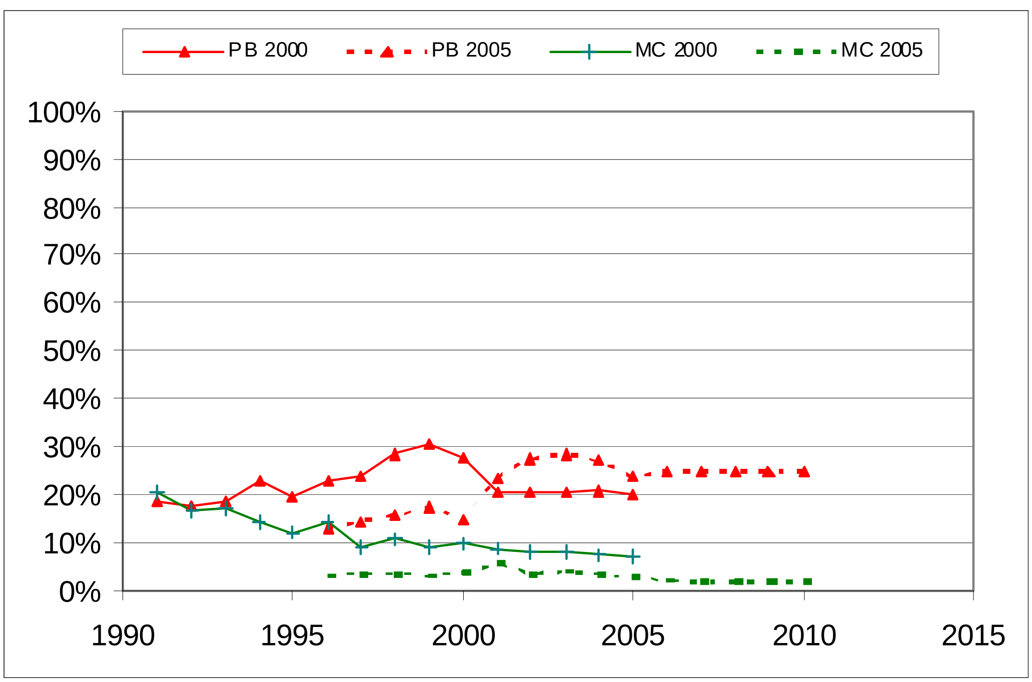
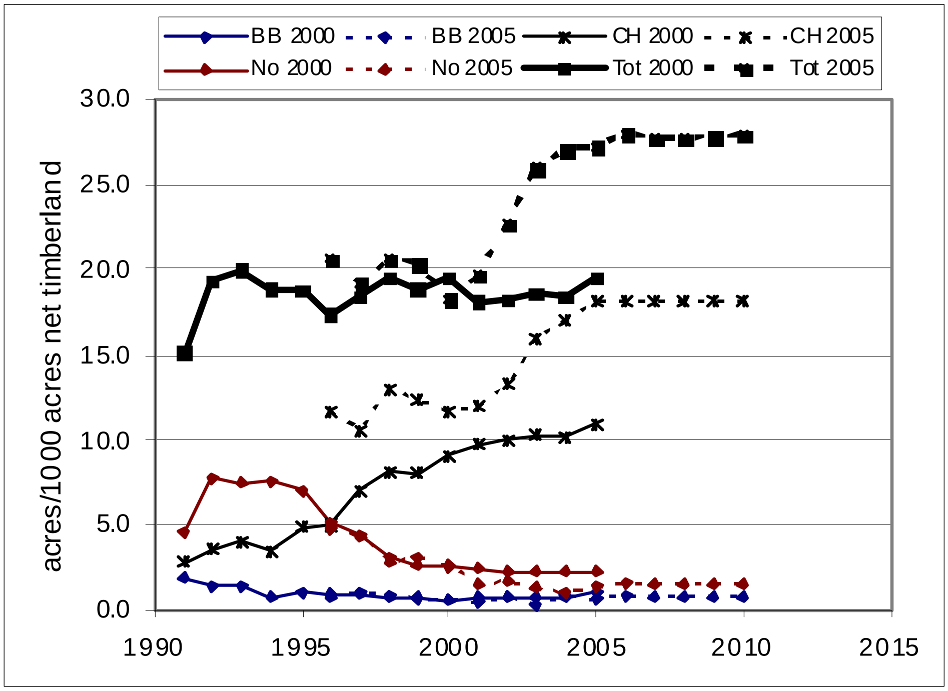


Figure 5.6 Site Preparation Method Trends for the 2001 and 2005 Surveys, Acres/1000 Acres Net Timberland. Broadcast burn (BB), pile & burn (PB), mechanical (MC), chemical (CH), none (No), Total (Tot)



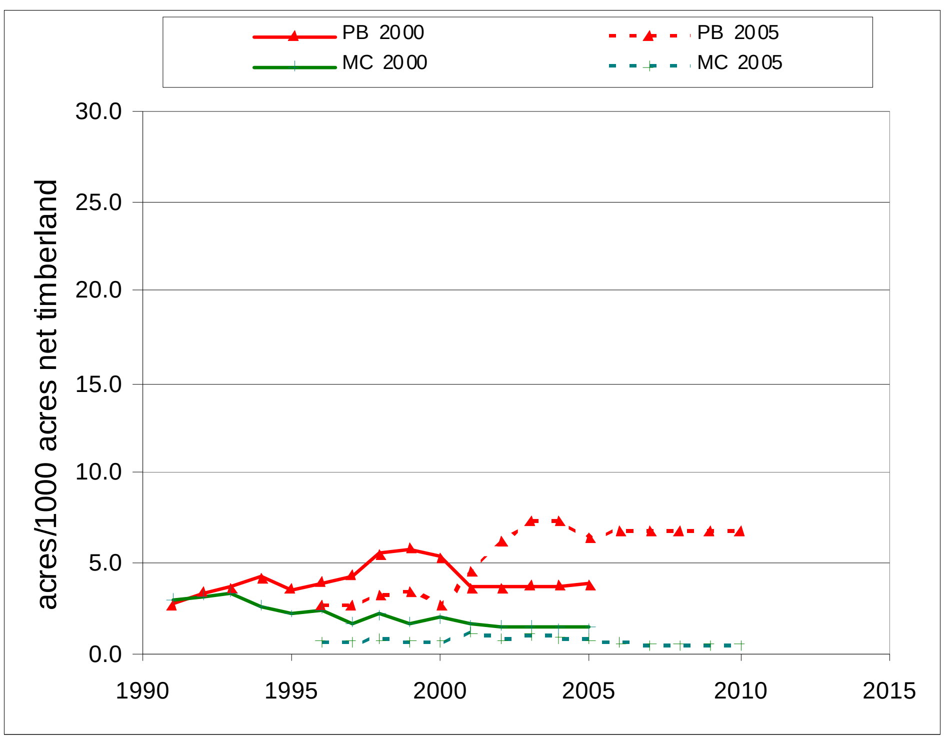
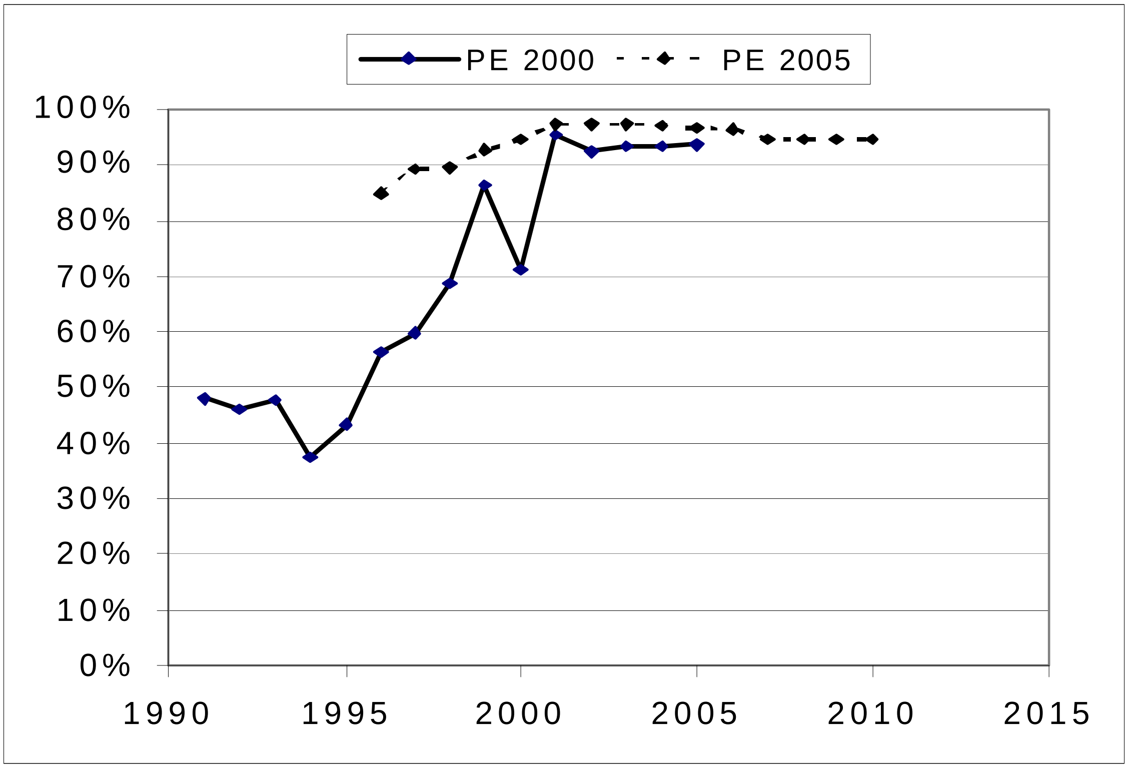


Figure 5.7 Pre-emergent (PE) Site Preparation, Percent of Chemical Site Preparation.

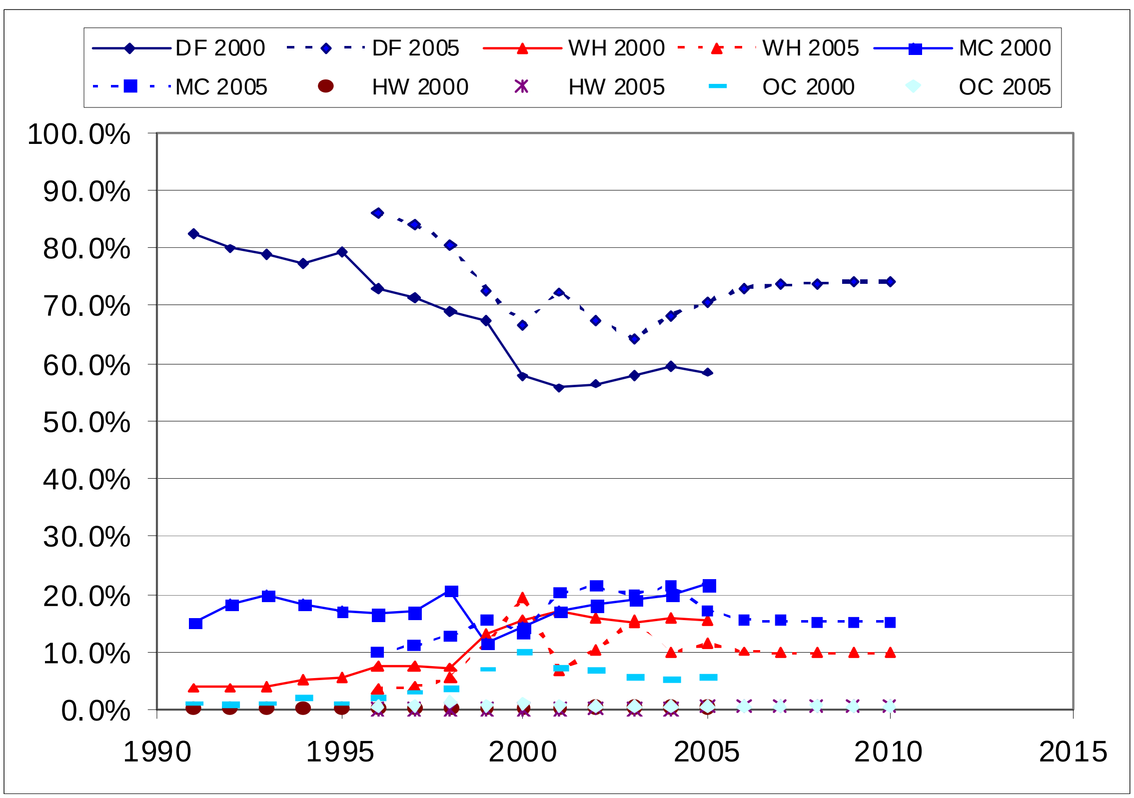


CHAPTER 6: REGENERATION

The average regeneration size unit reported by 2001 and 2006 respondents was 51 acres (se 6.7A) and 56 acres (se 4.5A) respectively. These figures closely agree with the average harvest unit sizes of 57A (se 7.5) in 2000 and 53A (se 4.7) in 2005. 2001 respondents reported that 98 % of regeneration was accomplished by planting seedlings whereas 2006 respondents reported that 100% of regeneration was via planted seedlings.

Figure 6.1 presents the overall percentage mix of regeneration by species. Since all regeneration is via planted seedlings, these terms can be considered synonymous in this report. Between 1990 and 2000, 2001 respondents indicated that Douglas-fir had dropped from more than 80% to less than 60% of regenerated net timberland and they expected it to remain at 55-60%. The trend reported by 2006 respondents is similar but at a higher level; they reported a decline from more than 85% to 70% between 1995 and 2005 and expect Douglas-fir to account for 75% of regenerated land in the future. Both surveys report that mixed conifers account for 15-20% of the regenerated land while regeneration of hemlock has risen from 5% to about 10%. Regeneration of land with other conifers has been between 1 and 3% and hardwoods have grown from 0.5% to about 1%.

Figure 6.1 Percentage of Regeneration, by Species. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)



6.1 Planting Intensity Trends per 1000 Acres of Net Timberland

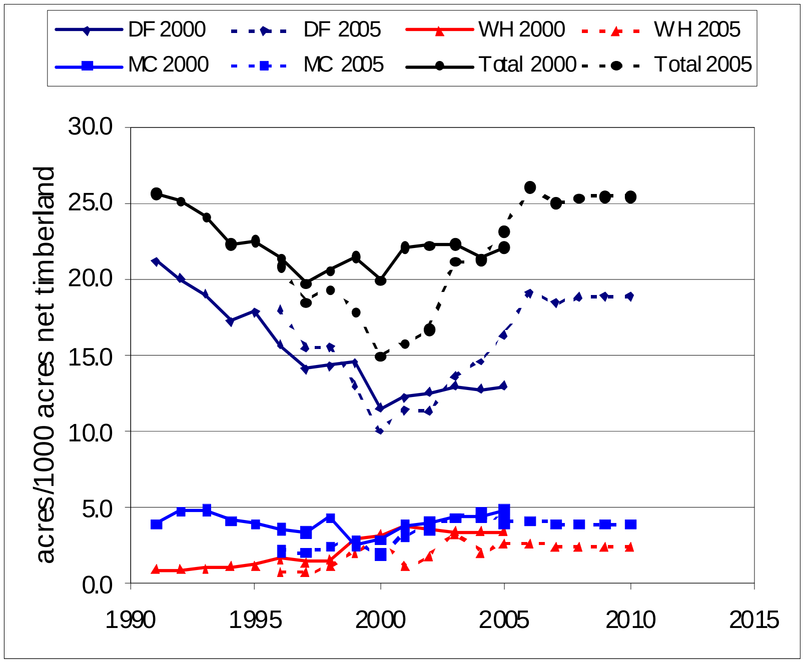
Figure 6.2 presents trends in regeneration activity per 1000 acres of net timberland for the 2001 and 2006 surveys. Since some respondents did not provide data at the species level, the species composition values may not sum exactly to the overall total. As in the trends in other chapters, the last 5 points in each survey's series are projections made by the respondents for the next 5 years.

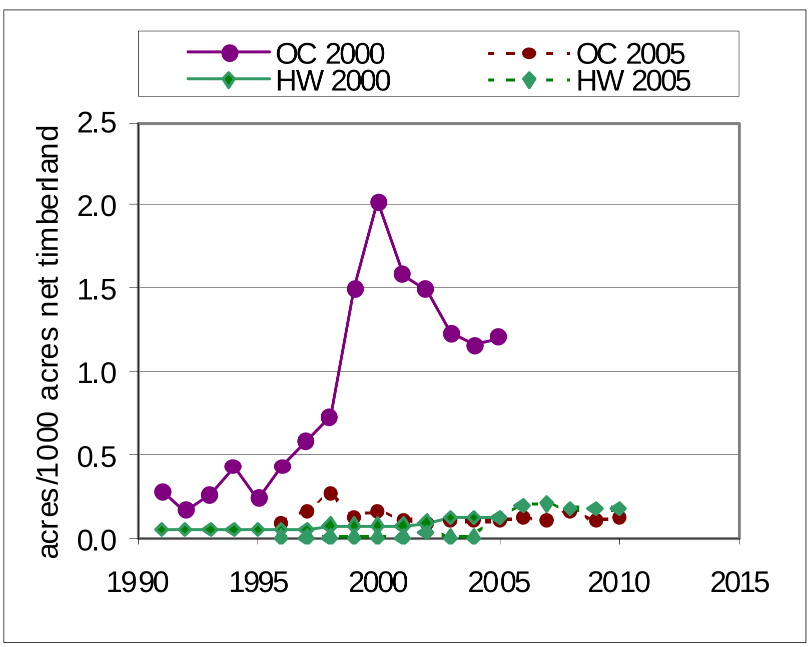
Total planting intensity reported by the 2001 respondents dropped from about 25 A/1000A in 1991-93 to 20-22A/1000A; they projected a slightly higher level (23A/1000A) between 2001 and 2005. The 2006 respondents reported a decrease to 15A/1000A in 2000 followed by a steady increase to 24A/1000A in 2005; they project a level of about 25 A/1000A in the future.

The two surveys reported similar planting intensity trends for Douglas-fir; a decline from 21 to 10-12A/1000A between 1990 to 2000. However, while 2001 respondents expected a modest increase to about 13A/1000A, 2006 respondents reported a steady increase to 16A/1000A in 2005 and they expect this to rise to 18-19A/1000A.

Planting intensity for western hemlock has grown from about 1 to 3 A/1000A, while that for mixed conifers has fluctuated between 4 and 5A/1000A. Planting intensity for other conifers has fluctuated between 0.25 and 2.0A/1000A while planting intensity for hardwoods has risen from nearly zero to about 0.25A/1000A.

Figure 6.2 Planting Trends for the 2001 and 2005 Surveys, Acres/1000Acres of Net Timberland, by Species. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)





6.2 Planting Intensity Trends per 1000 Acres of Species Net Timberland Type

Figure 6.3 provides a different perspective by expressing the regeneration of each species in terms of 1000 acres of that species type. Between 1990 and 2000, 2001 respondents reported that the planting intensity rate on Douglas-fir timberlands decreased from 34 to about 19A /1000 A and they expected the level to remain at about 20A/1000A. The 2006 respondents reported a decline to 15A/1000A in 2000 followed by recovery to 24A/1000A in 2005; they expect the intensity to increase to 27A/1000A in the future.

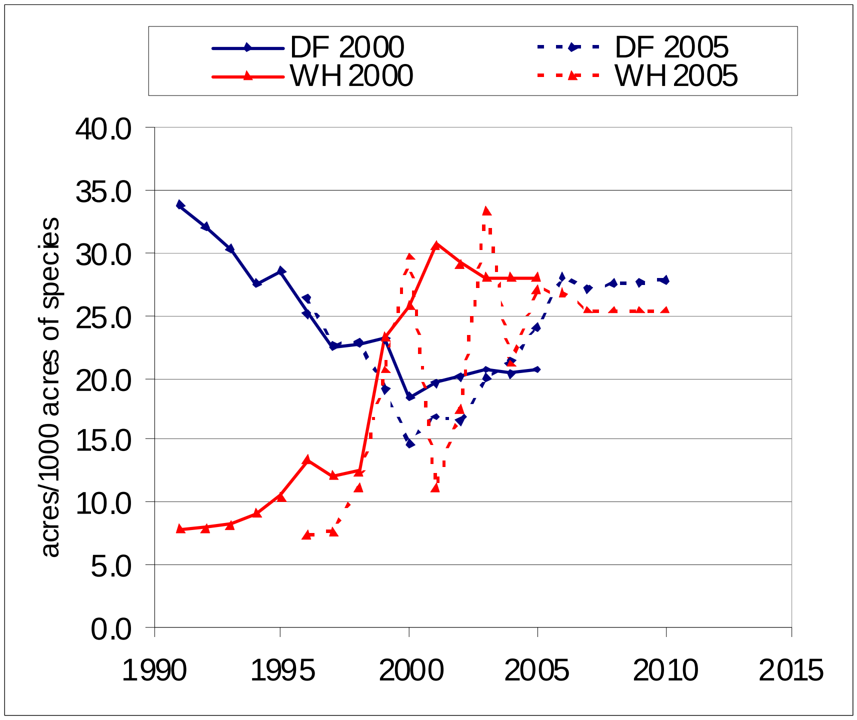
Regeneration intensity on western hemlock land has grown from about 7A/1000A in 1990 to levels that equaled Douglas-fir by 1999 and often exceeded Douglas fir between 2000 and 2005. 2006 respondents expect the hemlock regeneration intensity to stabilize at about 20A/1000A in the future.

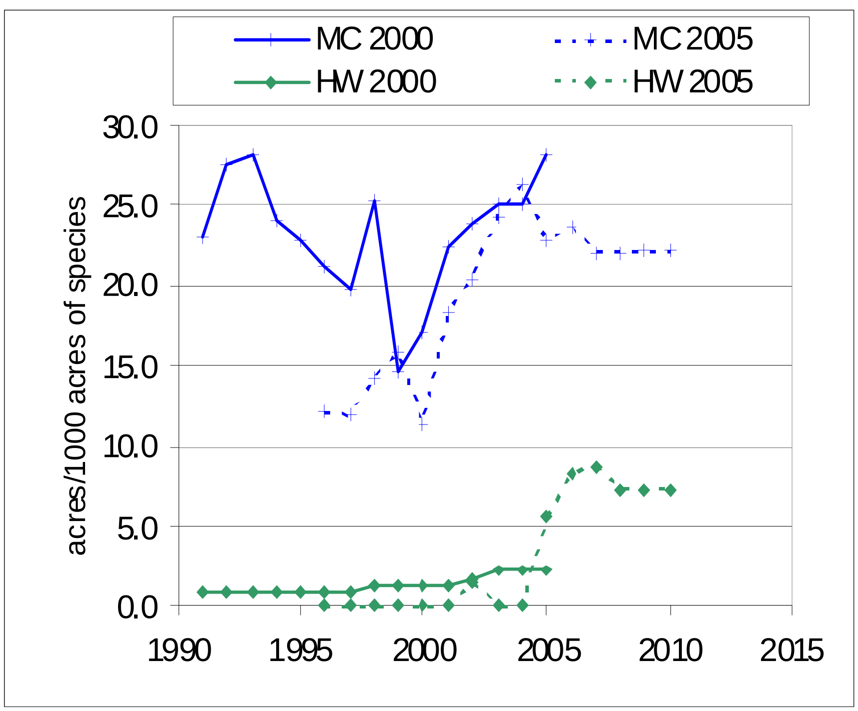
2001 respondents reported regeneration intensities of 24-28A/1000A on mixed conifers in 1990-93 that declined to 15-17A/1000A by 2000; they expected the intensity would rebound and grow from 23 to 28A/1000A in 2001-05. The 2006 respondents reported lower intensity (12-15A/1000A) between 1995 and 2000, followed by an increase to 25A/1000A in 2004; they expect the intensity to be about 22-23A/1000A in the future.

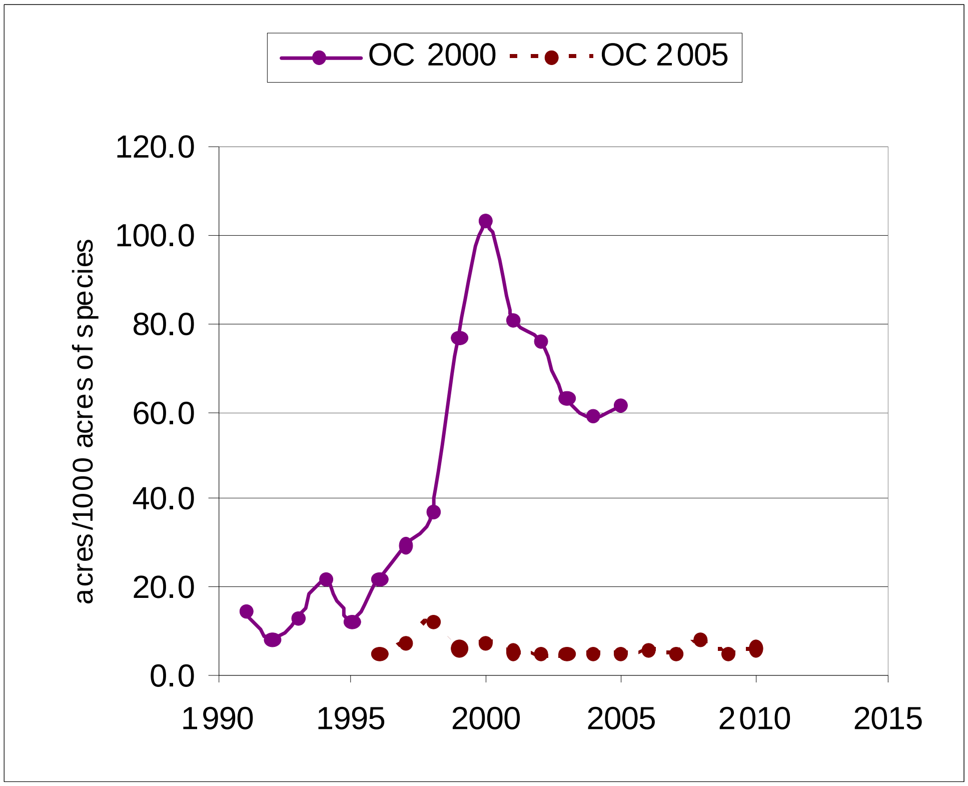
The planting intensity for other conifers shows great inconsistency between the two surveys; respondents to the 2006 survey indicate a relatively flat trend of about 5A/1000A while the respondents to the 2001 survey show much higher and more fluctuating data. We have no explanation for the difference.

The planting intensity for hardwoods (alder) increased steadily from 1A/1000A or less in the early 1990's. 2006 respondents reported an intensity of 5A/1000A in 2005 and expect this to rise to 7-8A/1000A in the future.

Figure 6.3 Planting Intensity Trends, Acres/1000Acres of Species Net Timberland Type. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)



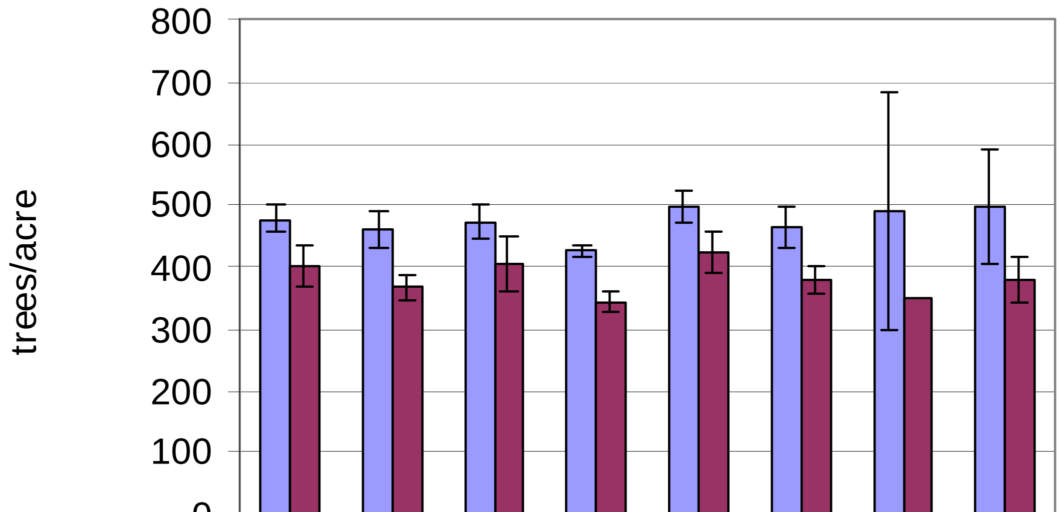



OC 2000
OC 2005
120.0
100.0
80.0
60.0
40.0
20.0
0.0
acres/1000 acres of species
1990
1995
2000
2005
2010
2015

6.3 Stocking Targets

Figure 6.4 indicates desired stand densities by species in trees per acre at planting and at age 10 for the 2001 and 2006 surveys. In all conifers, the mean target densities at planting and at age 10 have decreased slightly; the error bars indicate that these differences are not likely to be statistically significant. For hardwoods, there was a small increase in the targets. However, only 2 respondents to the 2001 survey were planting hardwoods (red alder) and no error bar could be calculated for the 10 year hardwood density target. In the 2006 survey three respondents provided hardwood stocking target data.

Figure 6.4 Regeneration Stocking Targets by Species (± se). Douglas-fir (DF), Western hemlock (WH), other conifer (OC), hardwood (HW)



	DF 2000	DF 2005	WH 2000	WH 2005	OC 2000	OC 2005	HW 2000	HW 2005
Planting	478	462	473	427	499	464	490	499
Age 10	402	368	405	345	424	378	350	380

6.4 Seedling Stock Types by Species

For each species respondents were asked to indicate the number of seedlings planted per year by seedling stock type: 1+1, p+1, small plug (SP; <= S8 or equivalent), large plug (LP; > S8 or equivalent), or other (O, most indicated these were 2-0 seedlings).

Figure 6.5 presents trends in the mix of Douglas-fir seedling types. P+1 seedlings have grown to about 50% in 1990-95 to about 60% since then and are expected to rise to 65% in the future. 1+1 seedlings have grown to nearly 20% of the mix and large plug seedlings increased to nearly the same level as 1+1 seedlings. Small plug and other seedling types have diminished to negligible use.

Figure 6.5 Seedling Stock Types for Douglas-fir, %

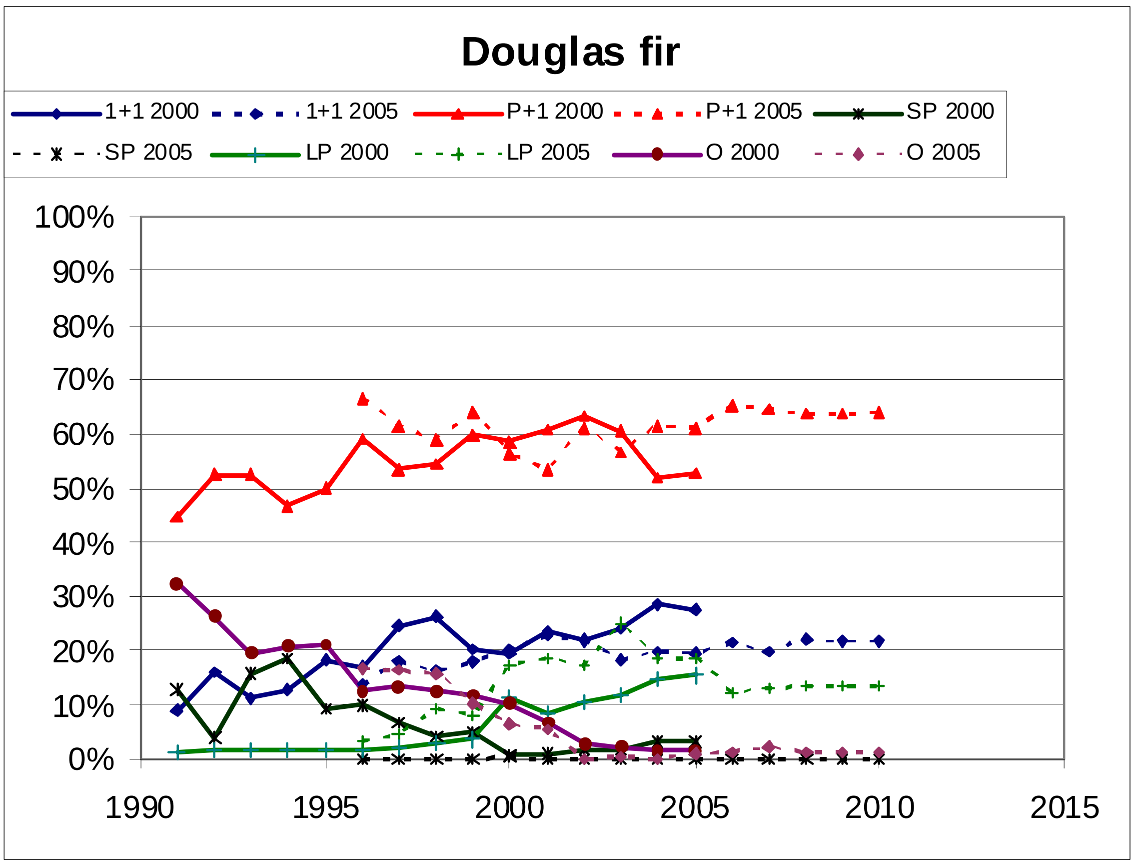


Figure 6.6 presents trends in the mix of western hemlock seedling types. In the early 90's, 2+1 seedlings accounted for 100% of the planted western hemlock but rapidly declined to 30% in 2000 and to 10% in 2005. The 2+1 seedlings have been replaced by large plug seedlings with other seedling types accounting for negligible quantities,.

Figure 6. 6 Seedling Stock Types for Western Hemlock, %

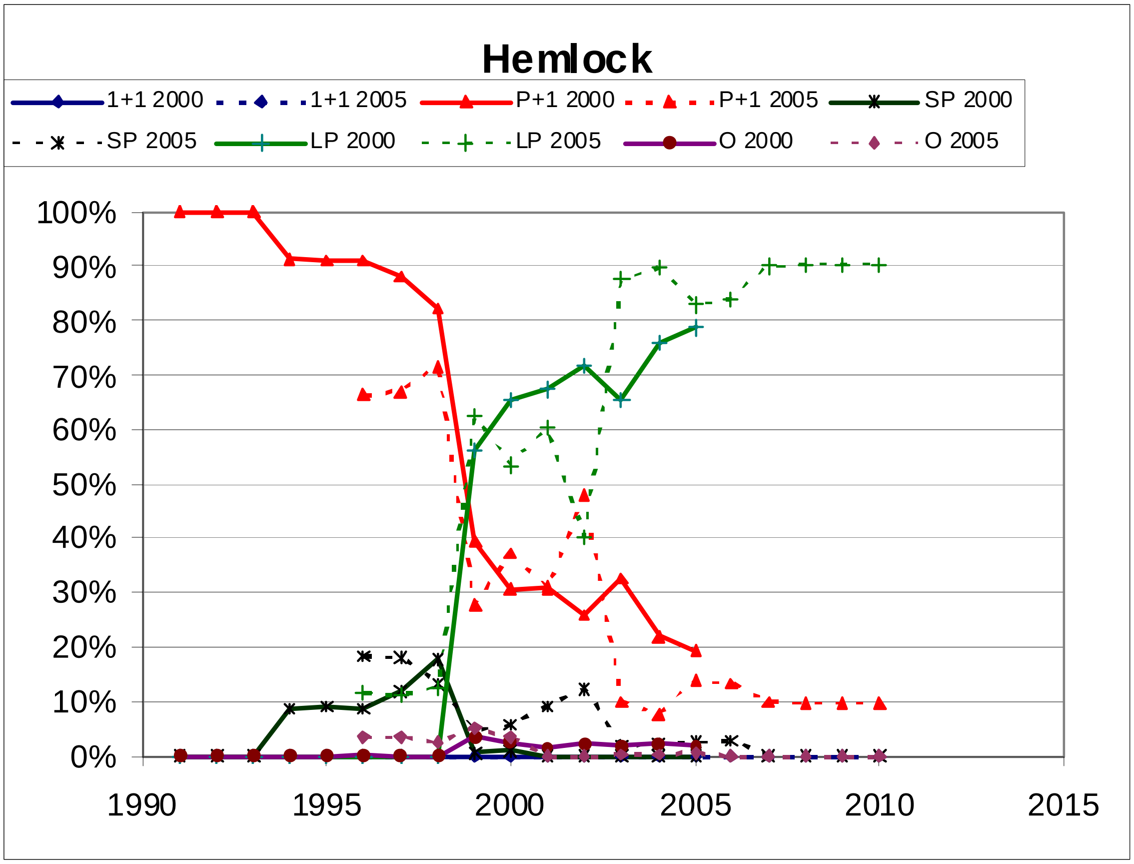


Figure 6.7 presents trends in the mix of western red cedar seedling types. Separate data for cedar was not collected in the 2001 survey. 2006 respondents report that P+1 and large plug seedlings are the only cedar seedling types planted. There have been wide swings between these two seedling types in the past but the 2006 respondents expect a nearly even split between these seedling types in the future.

Figure 6.7 seedling Stock Types for Western red cedar, %

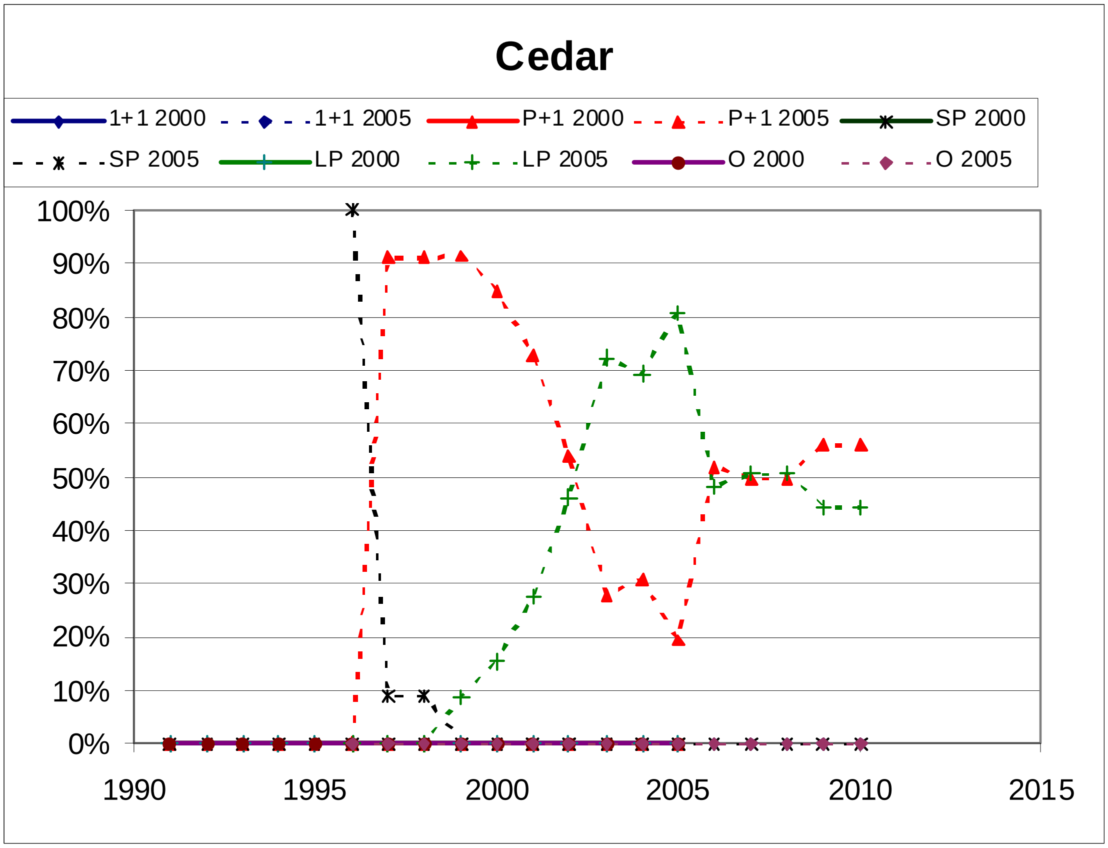


Figure 6.8 presents trends in the mix of other conifer seedling types. This data was not collected in the 2001 survey. Initially, P+1 accounted for about 60% of the other conifer seedlings with the balance small plugs. Large plug seedlings now account for about 70% with P+1 accounting for most of the balance; small plug other conifer seedlings are now near zero.

Figure 6.8 Seedling Stock Types for Other Conifers, %

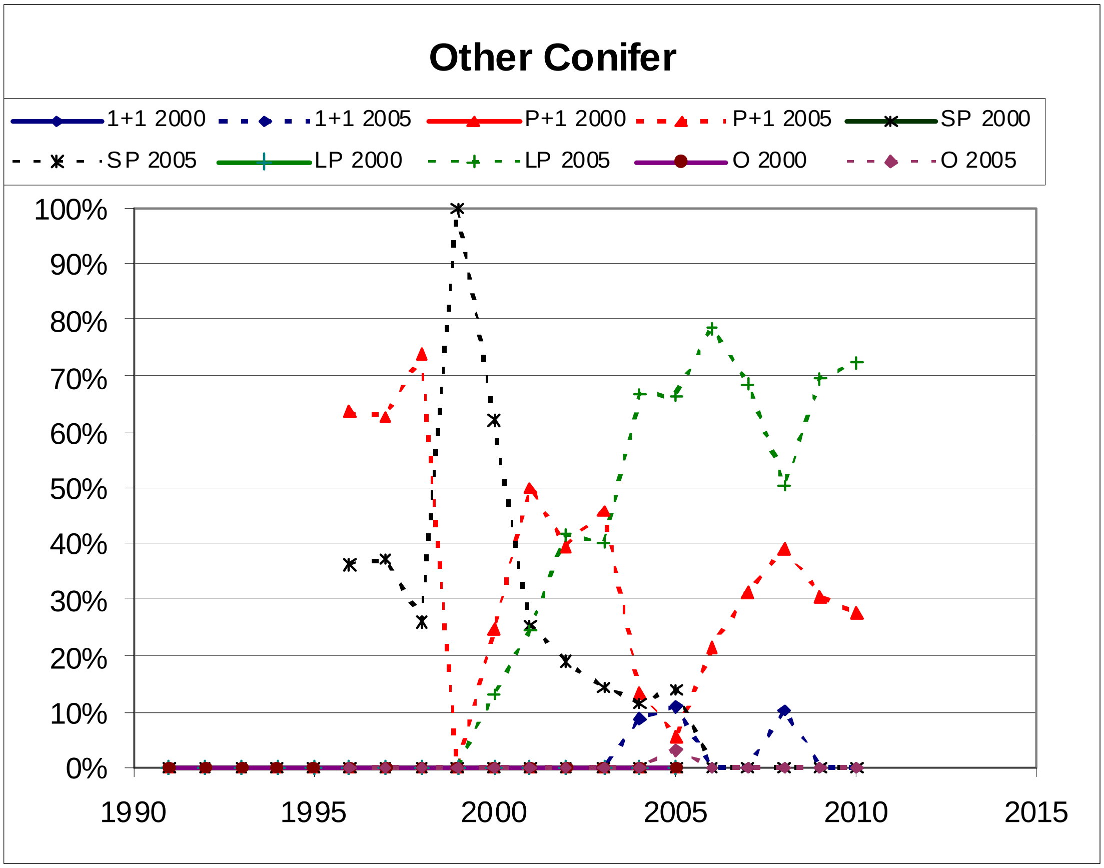
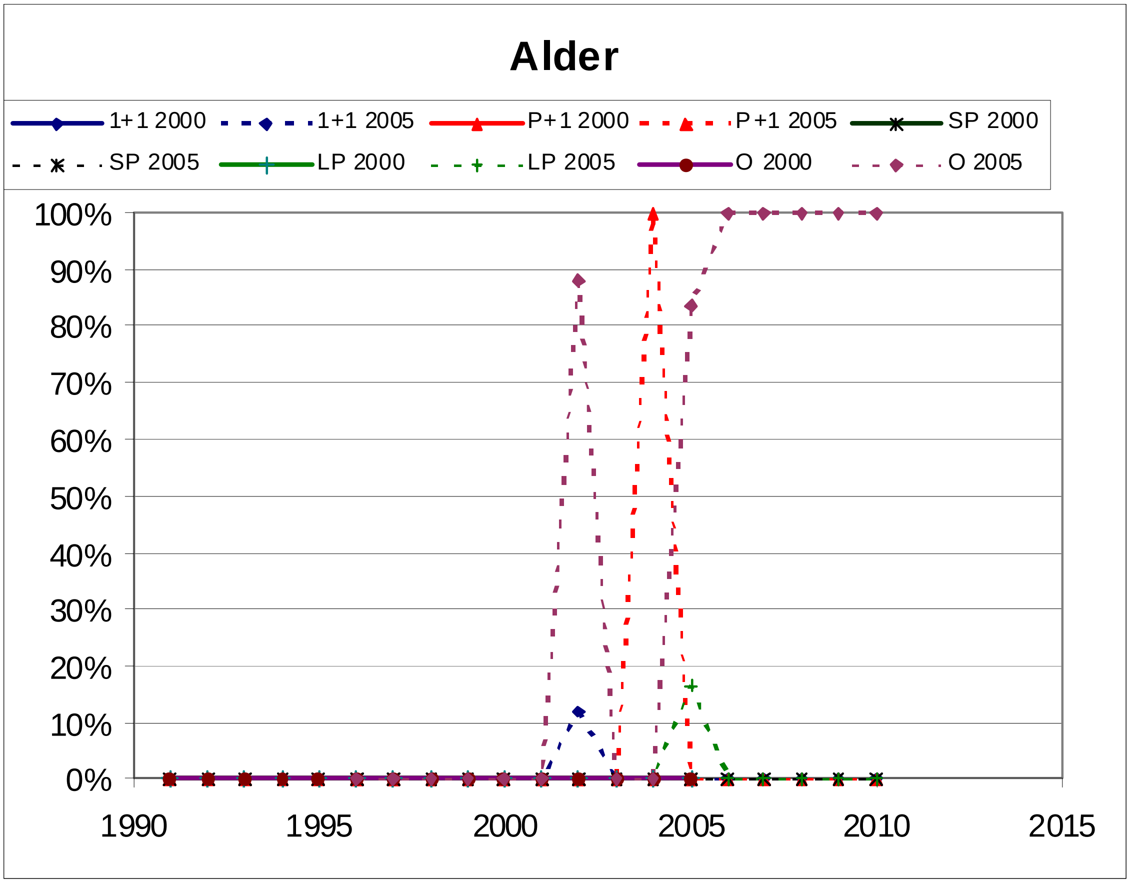


Figure 6.9 presents trends in the mix of red alder seedling types. This data was not collected in the 2001 survey. Respondents did not plant alder seedlings prior to 2002. Since then, there has been a mix of P+1, large plug and other alder seedling stock types. Since planting alder is new and relatively small, the evolution of alder planting stock may change greatly in the future.

Figure 6.9 Seedling Stock Types for Red Alder, %



CHAPTER 7: VEGETATION MANAGEMENT PRACTICES

Figure 7.1 presents the overall percentage mix of vegetation management by species. Between 1990 and 2000, 2001 respondents indicated that Douglas-fir slightly dropped from 91% to 88% of net timberland with vegetation management and they expected it to drop to 70-65%. Between 1996 and 2000, 2006 respondents report a level similar to that of the 2001 respondents. However, the 2006 respondents report less decline, to 80%, than was projected and they expect Douglas-fir timberland to continue to account for 80% of vegetation management in the future. Vegetation management on mixed conifer land has grown from 9%to 20% of the vegetation management. Although 2001 respondents expected hemlock land to account for 10% of vegetation management, this did not materialize. Vegetation management of hemlock, other conifers and hardwoods has been negligible.

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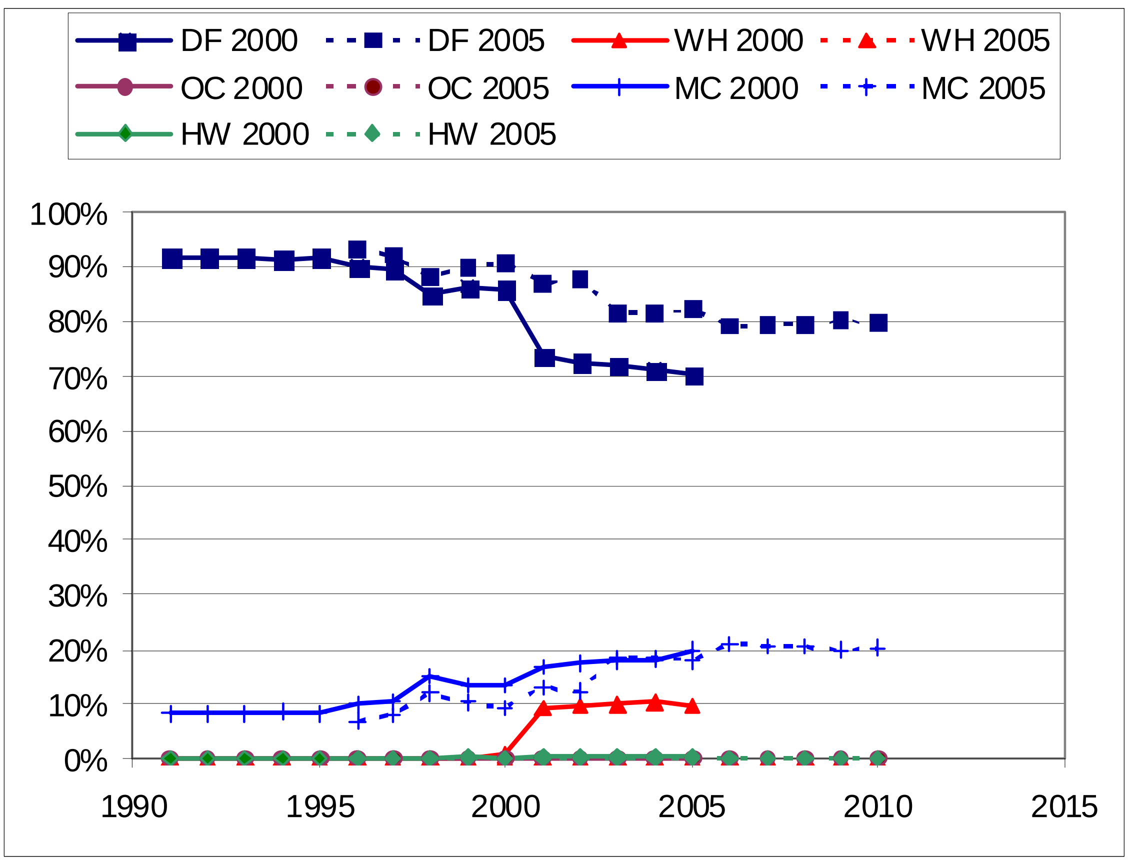
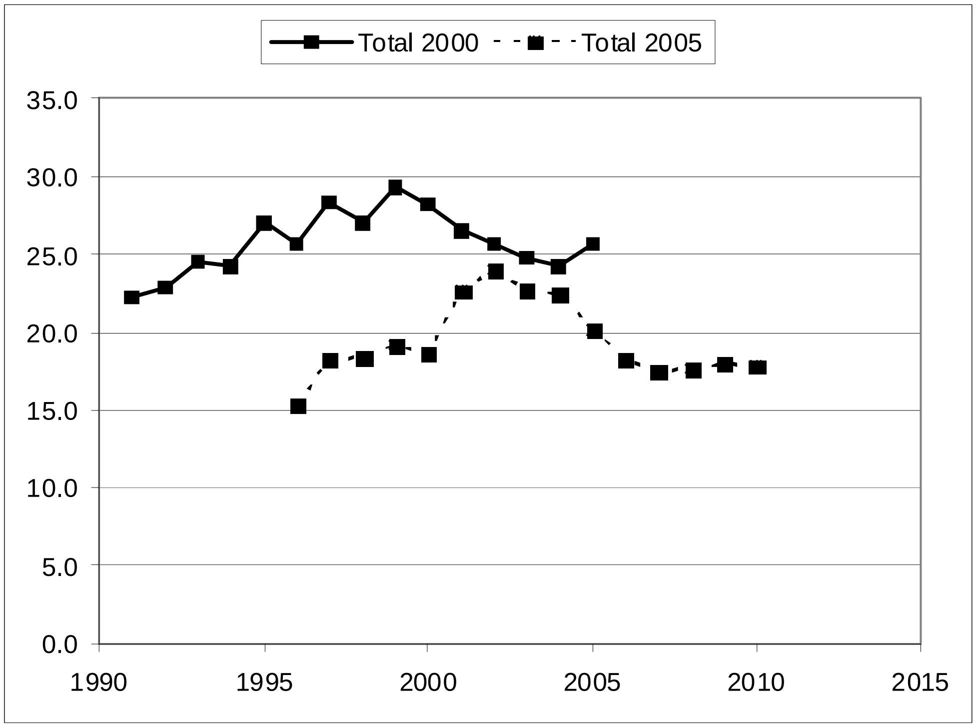
Figure 7.1 Percentage of Vegetation Management, by Species. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)

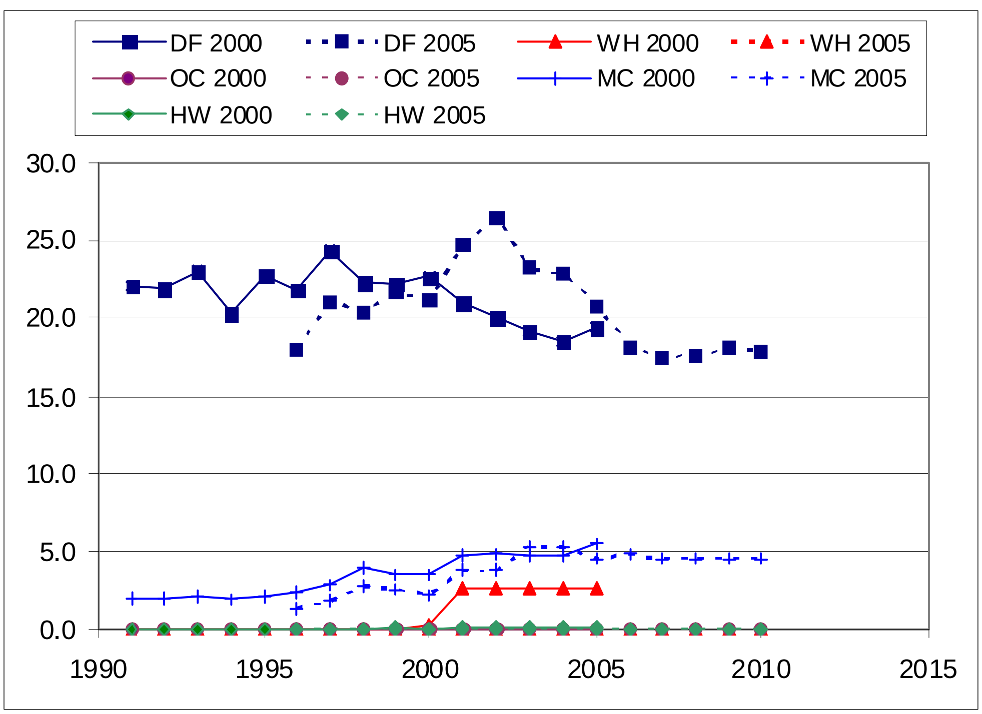


7.1 Vegetation Management Trends per 1000 Acres of Net Timberland

Figure 7.2 presents trends in vegetation management activity per 1000 acres of net timberland. Since some respondents did not provide data at the species level, the species composition values may not sum exactly to the overall total. As in the trends in other chapters, the last 5 points in each survey's series are projections made by the respondents for the next 5 years. 2001 survey respondents reported an increase in vegetation management intensity from about 22 A/1000A in 91-92 to 29 A/1000A in 2000 and expected a decline to 25 A/1000A in 2001-05. In contrast, 2006 respondents reported a lower but increasing trend that nearly reached the 25A/1000A level in 2002. Since then the intensity declined to 20A/1000A and is expected to drop to about 18A/1000A in the future. Douglas-fir has accounted for most of the activity and has fluctuated between 20-25A/1000A of net timberland. Mixed conifers accounted for the balance and have risen from 2.5 to 5A/1000A. The increase in hemlock expected by 2001 respondents did not materialize.

Figure 7.2 Vegetation Management Trends for the 2001 and 2005 Surveys, Acres/1000Acres of Net Timberland, by Species. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)

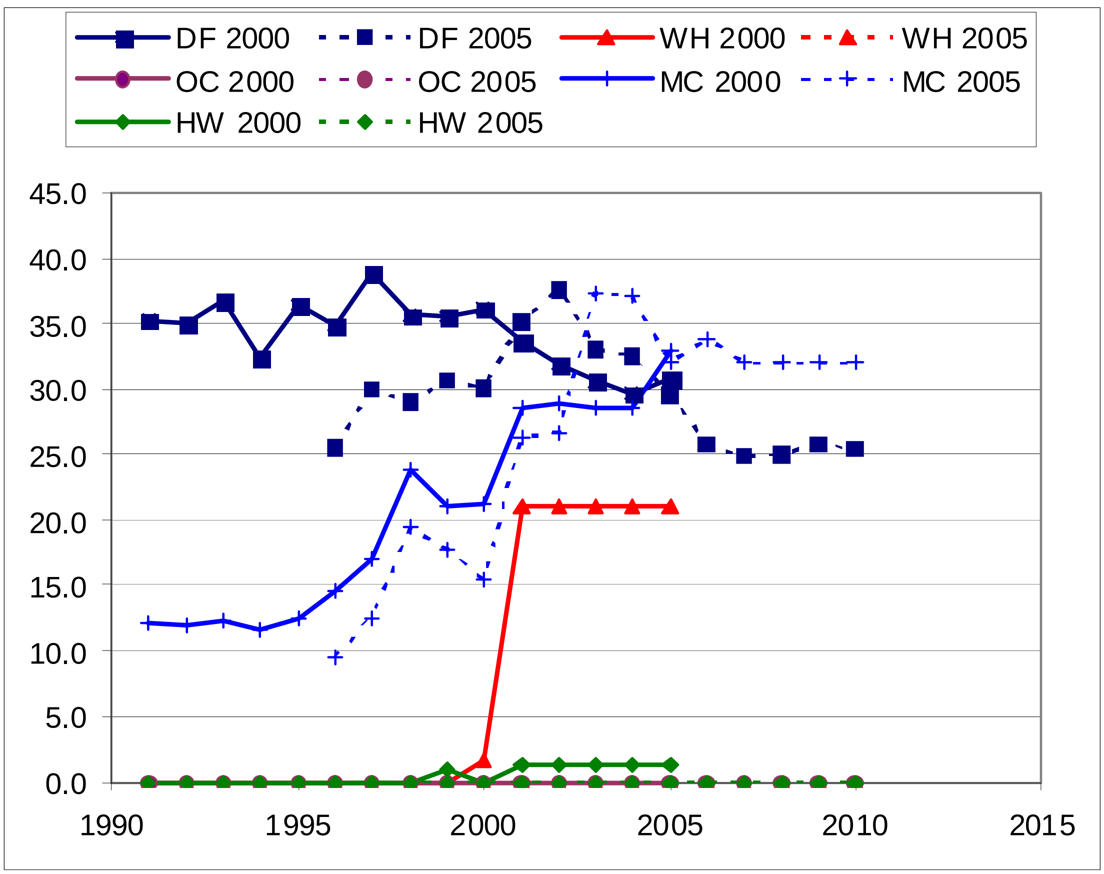




7.2 Vegetation Management Intensity Trends per 1000 Acres of Species Net Timberland Type.

Figure 7.3 provides a different perspective by expressing the vegetation management associated with each species in terms of 1000 acres of that species type. Vegetation management on Douglas-fir timberlands was about 35A /1000 A until 2002, declined to 30A/1000A in 2005 and is expected to drop to 25A/1000A in the future. Vegetation management of mixed conifer lands grew from 12 to 30-35A/1000A and is expected to remain at about 32A/1000A. Vegetation management intensity on hemlock, other conifer and hardwood land has been negligible; the increases expected by 2001 respondents for hemlock and hardwood did not materialize. Some of these trends may reflect movement of the cohorts of young stands in need of vegetation management into older age classes as well as increased emphasis on alternatives to pure Douglas-fir stands.

Figure 7.3 Vegetation Management Intensity Trends per 1000 Acres of Species Net Timberland Type. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)



7.3 Vegetation Management Methods

Figure 7.4 indicates that methods of vegetation management have shifted from release from woody (hardwood) competition, often several years after planting, to herbicidal control of vegetation in the first and/or second years following planting.

Figure 7.4 Vegetation Management, Percent by Method: Year 1 herbicide (Y1), Year 2 herbicide (Y2), woody release (WR), Other

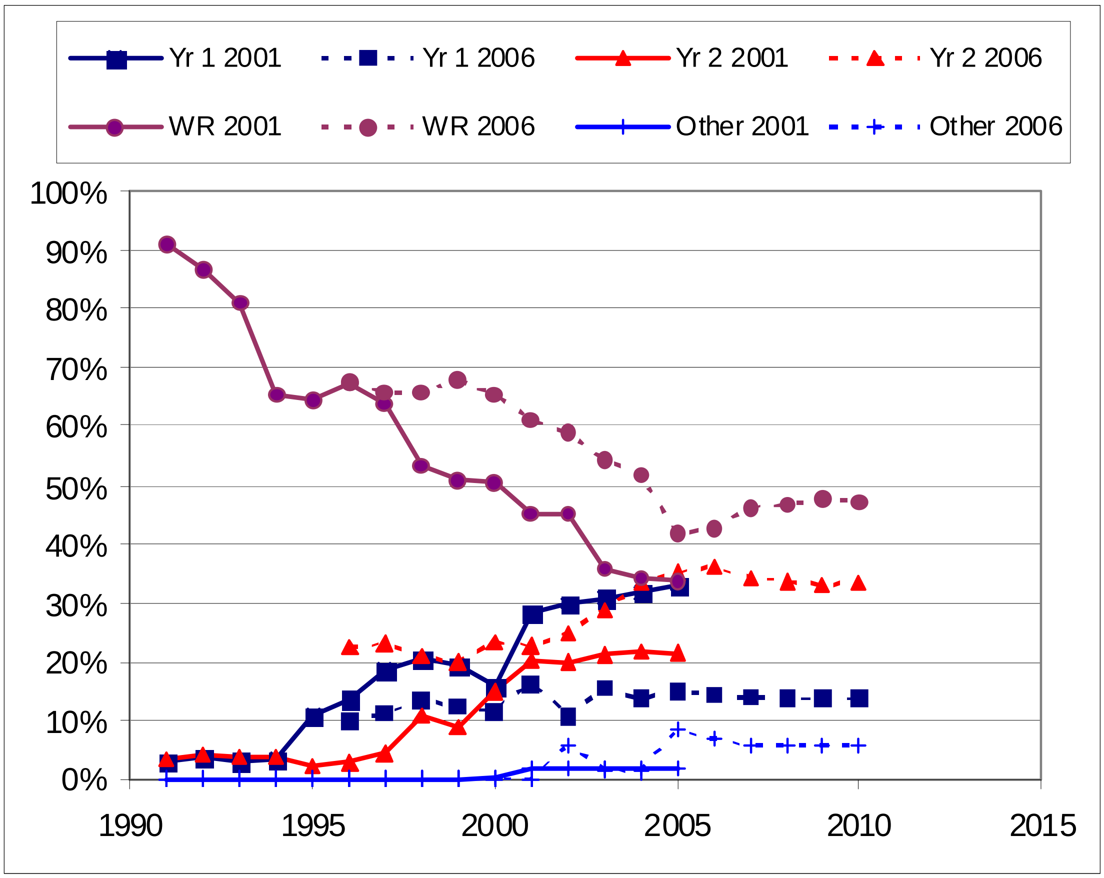
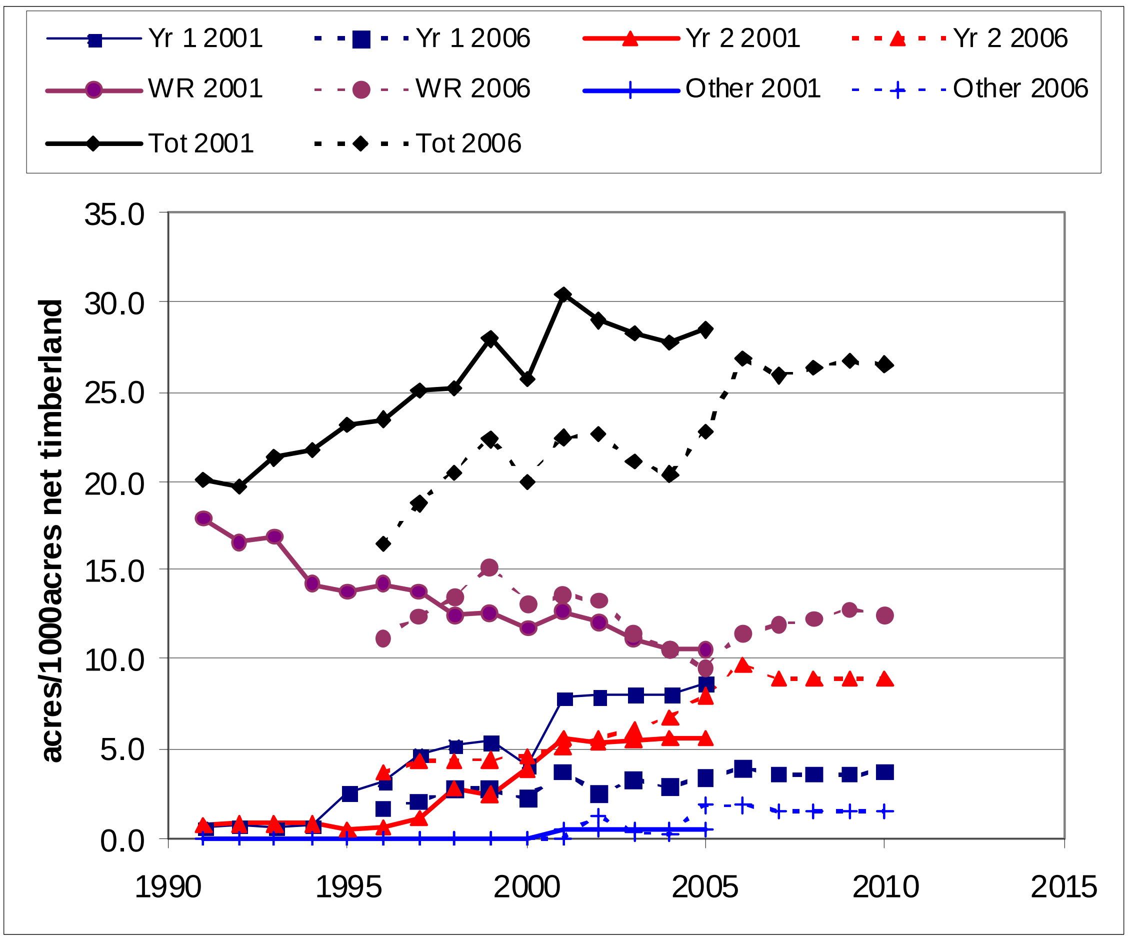


Figure 7.5 expresses vegetation management treatments as intensities in acres treated per 1000 acres of net timberland. Woody release declined from 16-18 A/1000A in 1991 to 10 A/1000A in 2005 but is expected to rise to 13A/1000A in the future. Year 1 herbicide control rose to about 3-5A/1000A but did not increase higher as was expected by the 2001 respondents; instead, it has remained at about 3A/1000A. Year 2 herbicide control lagged year 1 control until the late 1990's and has since grown to about 7A/1000A and is expected to rise further to 9A/1000A in the future. The shift from year 1 to year 2 herbicide control of competing vegetation may reflect increased use of pre-emergent site preparation chemicals (Chapter 4).

Figure 7.5 Vegetation Management Methods, Acres per 1000 Acres Net Timberland.

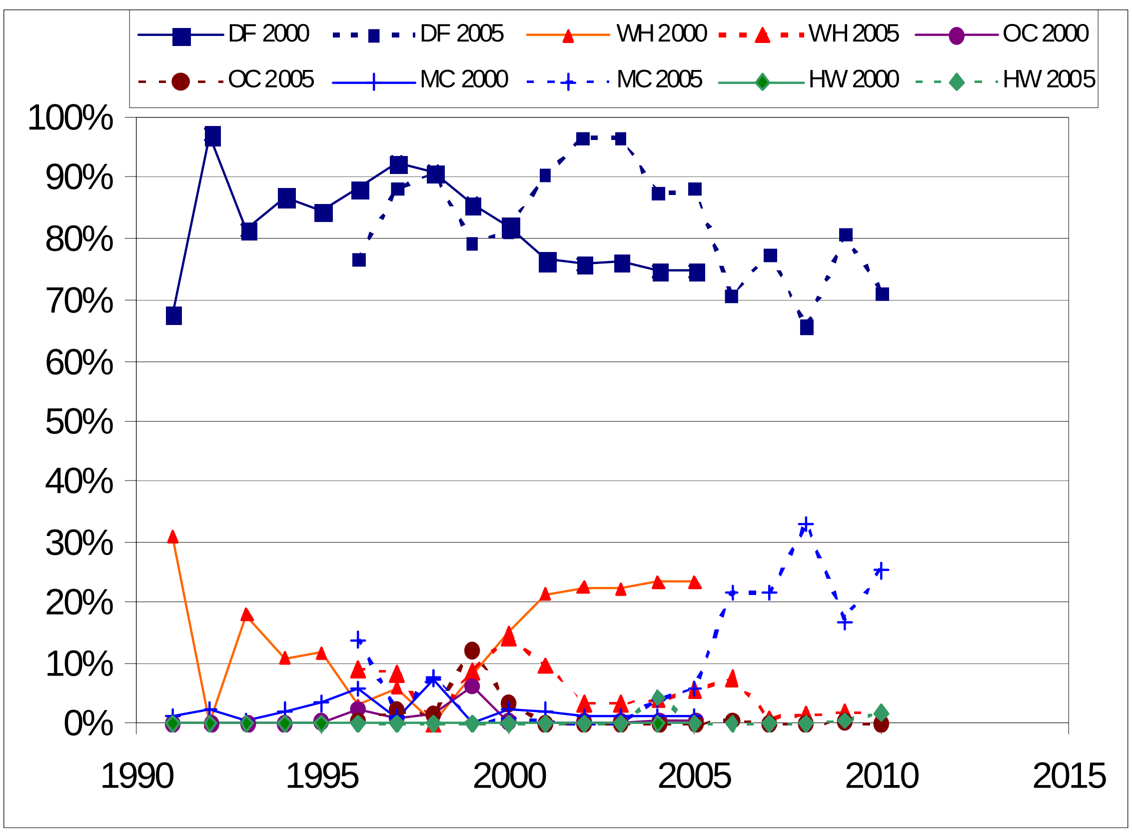


CHAPTER 8: PRE-COMMERCIAL THINNING

8.1 Pre-commercial Thinning (PCT)

The species mix of pre-commercial (PCT) thinning activity on net timberland was almost exclusively focused on Douglas-fir and western hemlock in 1990-94 (Figure 8.1). In 1995-99, while PCT of Douglas-fir and hemlock decreased, PCT of mixed conifer and other conifer stands increased. The reports from the 2001 and 2006 respondents are in reasonably good agreement up to 2000. The 2001 respondents expected a shift from Douglas-fir to hemlock whereas the 2006 respondents indicate more concentration on Douglas-fir and less on hemlock. The 2006 respondents also expect a future shift away from Douglas-fir and hemlock and increased emphasis on mixed conifers and the beginning of PCT of hardwoods

Figure 8.1 Pre-commercial Thinning on Net Timberland, % by species. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)



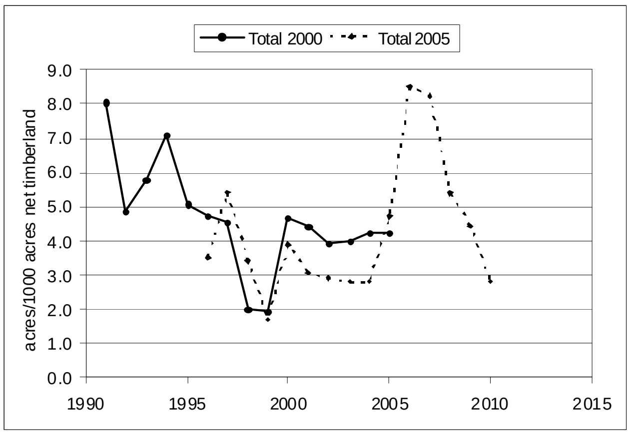
8.2 PCT, Acres/1000 Acres Net Timberland

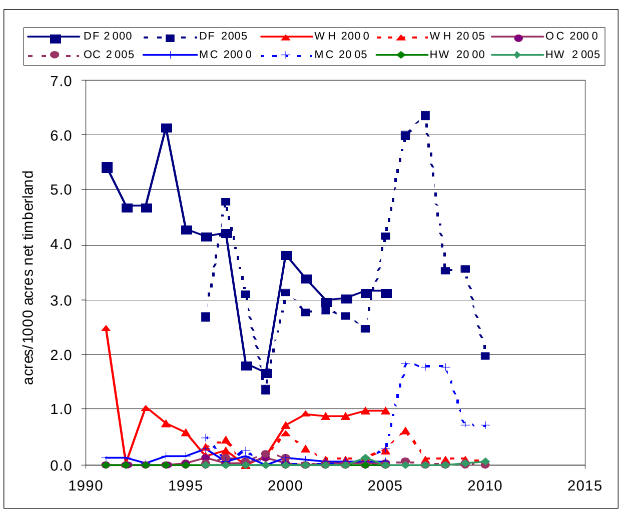
Figure 6.2 presents trends in total PCT activity per 1000 acres of net timberland reported by the 2001 and 2006 respondents. Generally, PCT declined from 8 A/1000A in 1991 to about 2 A/ 1000A in 1999. 2001 respondents reported more than 4.5 A/1000A in 2000 and expected the level to be about 4A/1000A through 2005. The 2006 respondents reported an actual level of PCT of about 3A/1000 A for 2001-2005, expect it to spike to the 1991 level and then return to 3A/1000A by 2010.

The species composition values may not sum exactly to the overall total since some respondents did not provide species-level detail. PCT of Douglas-fir dropped from 6 to 2A/1000A of net timberland, rose to about 3A/1000A in 2000-05 and is expected to increase to 6A/1000A before dropping to 2A/1000A.

Except for 1991, PCT of western hemlock has been no higher than 1A/1000A of net timberland and is expected to be very low in the future. PCT of mixed conifers has been negligible through 2005 but 2006 respondents expect an increase to nearly 2A/1000A before falling to about 1A/1000A.

Figure 8.2. Pre-commercial Thinning Intensity on Net Timberlands, A/1000A, by Species. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)





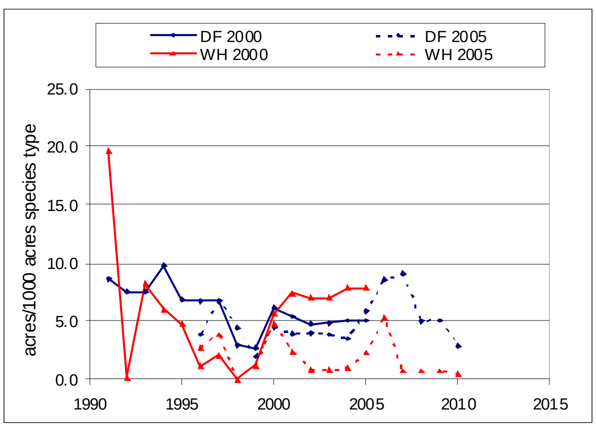
8.3 PCT, Acres/1000 A Species Net Timberland

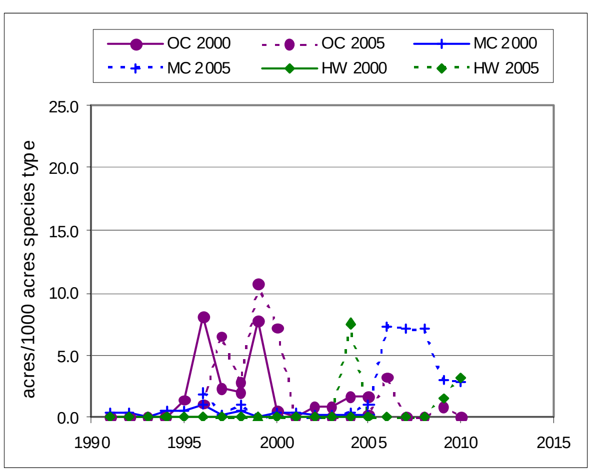
A different perspective of each species is shown in Figure 8.3 by expressing PCT intensity per 1000 acres of timberland of that species type. 2001 respondents reported PCT intensity on Douglas-fir land at 7-10 A/1000A from 1991-95. Since then, respondents to both surveys report levels that fluctuate around 5A/1000A. 2006 respondents projected an increase to 7-8A/1000A and then a drop to the level of the recent past.

Intensity of PCT on hemlock land was very high in 1991, 20A/1000A, but dropped to 5A/1000A or less since 1995. Although the 2001 respondents projected an increase to about 7 A/1000 A in 2001-2005, the 2006 respondents reported a decline to about 1-2A/1000A, a level they expect will be maintained, with the exception of 2006.

PCT on land occupied by other conifers began in 1995 and fluctuated around 5A/1000A until 1999 after which is has dropped to 1-3 A per 1000 A. PCT intensity on mixed conifer and hardwood land has been negligible until recently and both are expected to have PCT activity in the future.

Figure 8.3. Pre-commercial Thinning Intensity on Species Type Timberland, A/1000A. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)





CHAPTER 9: COMMERICAL THINNING

2001 respondents indicated that commercial thinning supplied about 3.5% of their total timber harvest volume in 2000 (Figure 9.1). In contrast, 2006 respondents reported that commercial thinning supplied only 0.67% of their harvest volume. This decline suggests a lowering of commercial thinning as part of silvicultural regimes.

Figure 9.2 presents the species mix of commercial thinning on net timberland. 2001 respondents reported that Douglas-fir slowly rose from 70% to 80% and hemlock declined from 30% to 12% during 1991-2000. During that time, commercial thinning of mixed conifers rose from zero to 15% and back to zero. 2001 respondents expected that commercial thinning mix in the future would be 70-75% Douglas fir, 20-25% hemlock, and less than 5% mixed conifers. 2006 respondents differ in that they reported no commercial thinning of mixed conifers, a higher Douglas fir percent, and a lower hemlock percent. None of the respondents to either survey reported commercial thinning of other conifers or hardwoods.

Figure 9.1 Commercial Thinning Volume as a % of Total Harvest Volume (± se)

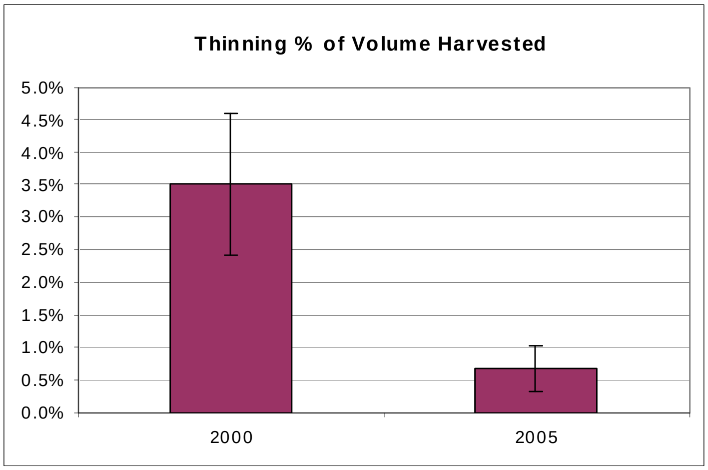
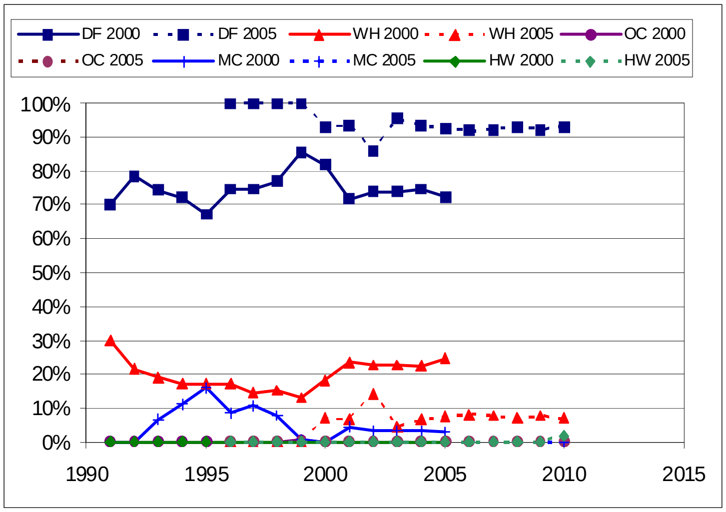


Figure 9.2 Percentage Mix of Commercial Thinning by Species. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC), other conifer (OC), hardwood (HW)



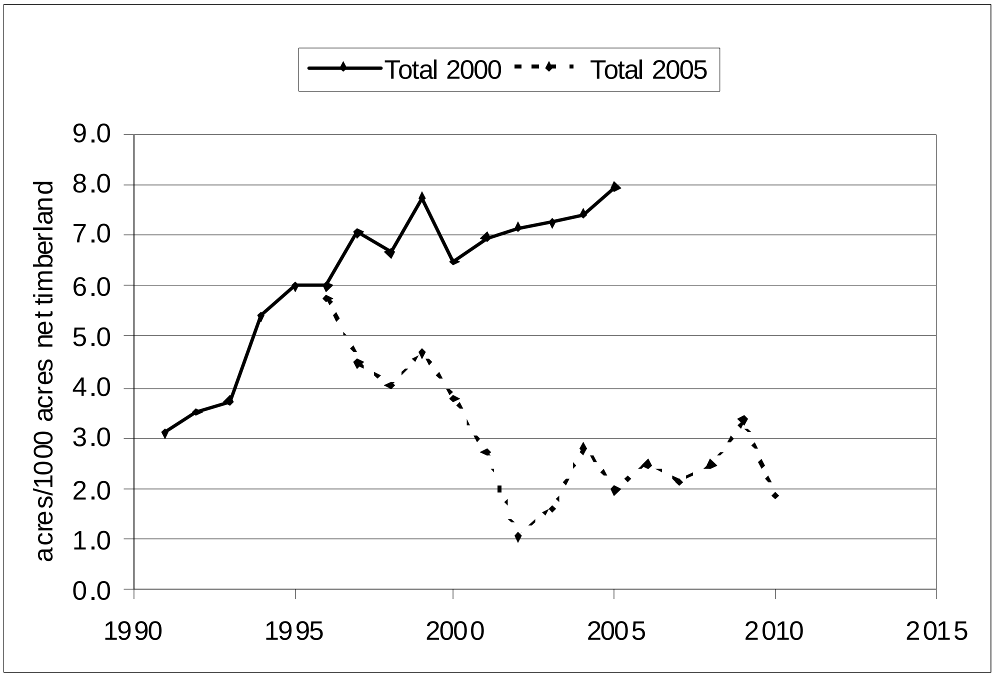
9.1 Commercial Thinning, Acres/1000Acres of Net Timberland

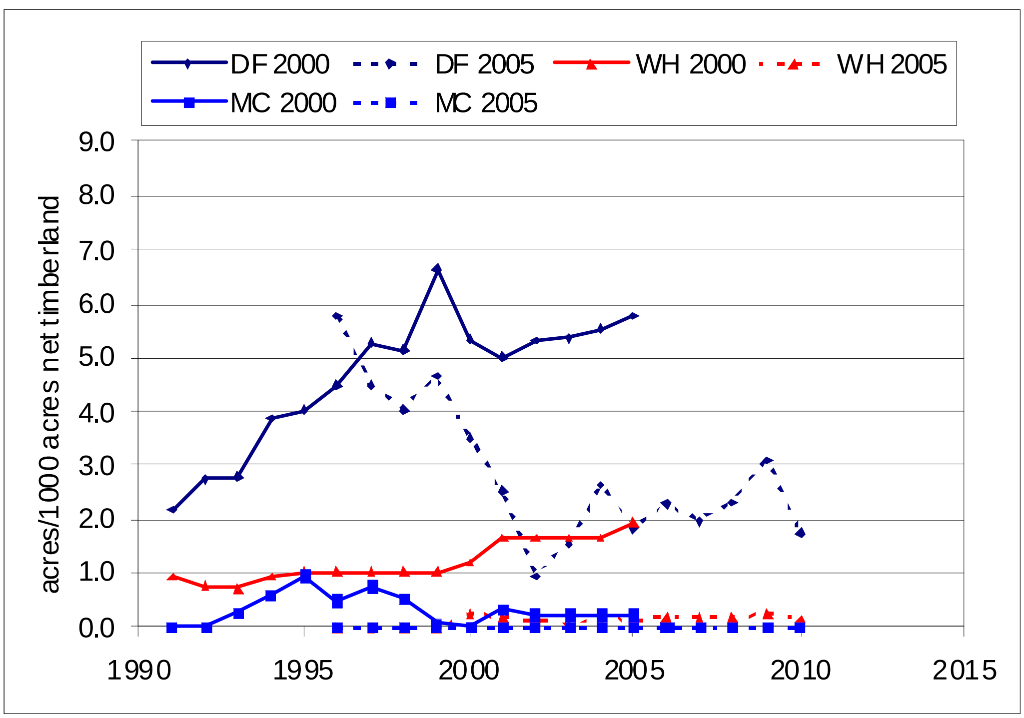
Figure 9.3 presents trends in commercial thinning per 1000 acres of net timberland. 2001 respondents reported that commercial thinning rose from about 3 to nearly 8 A/1000A between 1991 and 1999. Although the intensity dropped in 2000 to about 6.5A/1000A they expected it to rise to 8 A/1000A by 2005. This trend was not too surprising given the large acreages of 10-19 and 20-30 year old stands present at the start of the decade (Figure 2.2) that were prime candidates for commercial thinning. In contrast, the 2006 respondents report a very different trend and expectations. Starting with the same intensity as the 2001 respondents in 1996 (6A/1000A), 2006 respondents report that commercial thinning dropped to 4A/1000A in 2000 and dropped further since then to 1-3A/1000A. They expect intensity to stay low, between 2 and 3A/1000A in the future.

The species composition trends are similar to the total. Commercial thinning intensities in Douglas-fir closely mimic the pattern for the total; western hemlock, which was steadily increasing and projected to double, has dropped to very low levels; and commercial thinning of mixed conifers disappeared.

The reduced levels of commercial thinning may reflect a combination of several factors including (1) use of generally wider planting spacing since 1980, reducing the need for thinning, (2) prior PCT of stands now reaching commercial thinning age may have lessened the need for a later commercial thinning, (3) shortening of the rotation, (4) high per acre costs of thinning (Table 4.1), and, (5) low yield and market value timber from thinning.

Figure 9.3. Total Commercial Thinning, Acres/1000Acres of Net Timberland. Douglas-fir (DF), Western hemlock (WH), mixed conifer (MC)





9.2 Commercial Thinning, Acres/1000Acres of Species Net Timberland

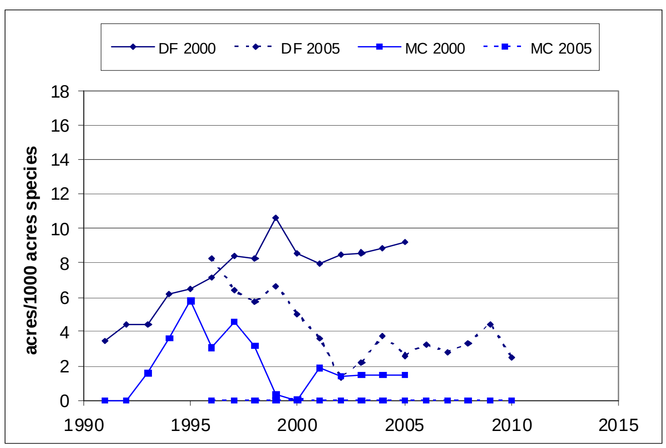
A different perspective of each species is shown in Figure 9.4 by expressing commercial thinning intensity per 1000 acres of timberland of that species type. The intensity of commercial thinning on Douglas-fir land more than doubled from less than 4 to more than 10 A/1000A between 1991 and 1999 and was projected be more than 8 A/1000A in 2001-2005. In contrast intensity actually fell to 2-4A/1000A.

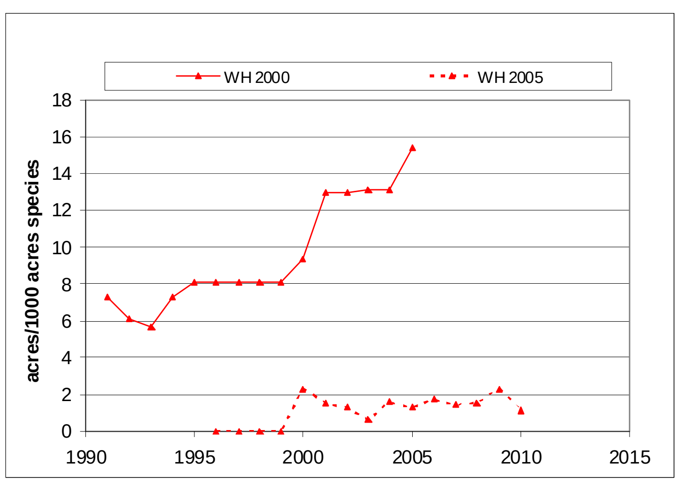
Commercial thinning intensity on hemlock land grew from 6 to 9 A/1000A by 2000 and was expected to rise further to 13-15 A/1000A in 2001-2005. Instead, the intensity level has fallen to about 2A/1000A where it is projected to remain.

Commercial thinning intensity on mixed conifer timberland had a surge to 3-6A/ 1000A in 1994-98, dropped sharply in 1999-2000, and was expected to be between 1-2 A/1000 A in 2001-2005. Instead, 2006 respondents expect no commercial thinning of mixed conifers.

Commercial thinning of timberlands occupied by other conifers has occurred just once during the decade and no commercial thinning has been conducted on hardwood timberlands.

Figure 9.4 Commercial Thinning, Acres/1000Acres of Species Timberland. Douglas-fir (DF), mixed conifer (MC), western hemlock (WH)

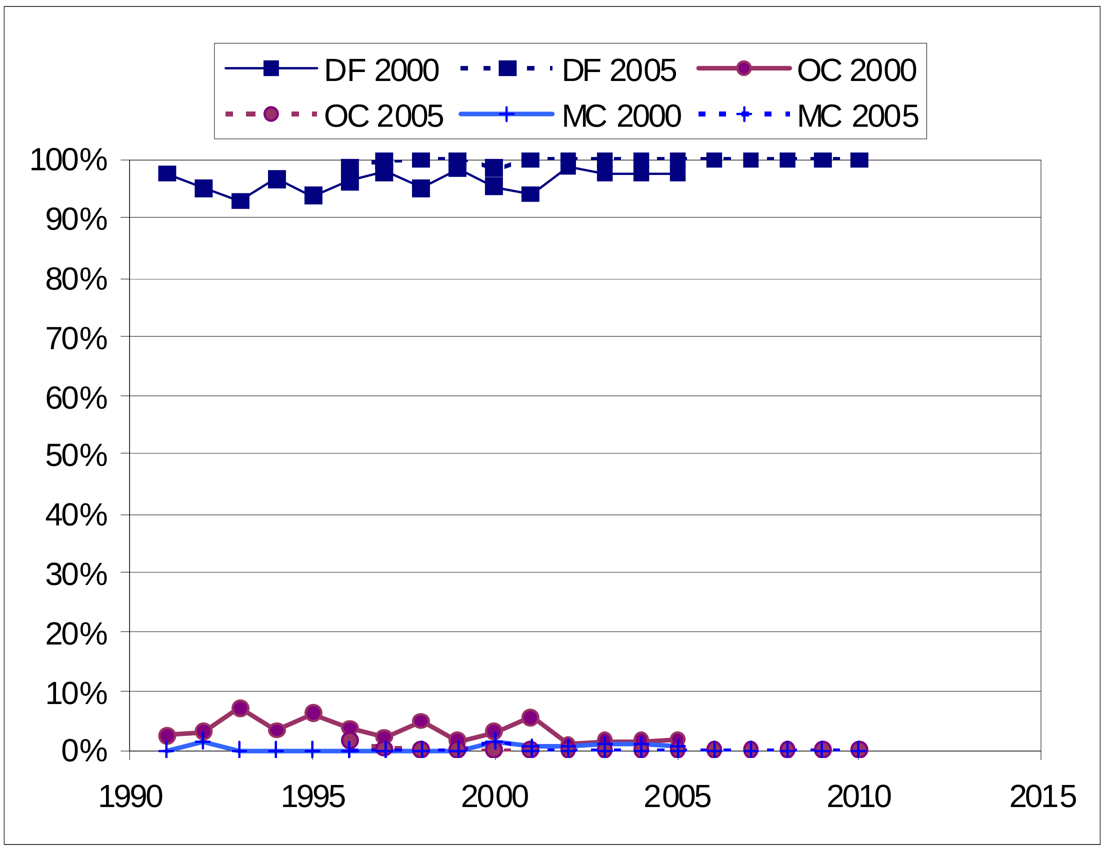




CHAPTER 10: FERTILIZATION

Figure 10.1 presents the percentage mix of fertilization on net timberlands. 2001 respondents reported that, on average, about 95% of fertilization was done on Douglas-fir with almost all of the balance on other conifers and a slight amount on mixed conifers. 2006 respondents report that 100% of their fertilization was on Douglas-fir timberland. None of the respondents to either survey fertilize hemlock or hardwoods. All respondents apply 200 lb N as urea per acre.

Figure 10.1 Percentage Mix of Fertilization on Net Timberland. Douglas-fir (DF), mixed conifer (MC), other conifer (OC)

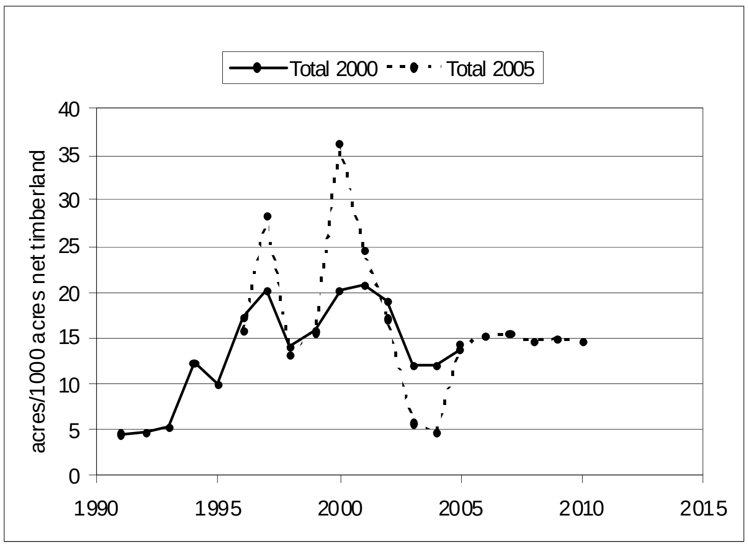


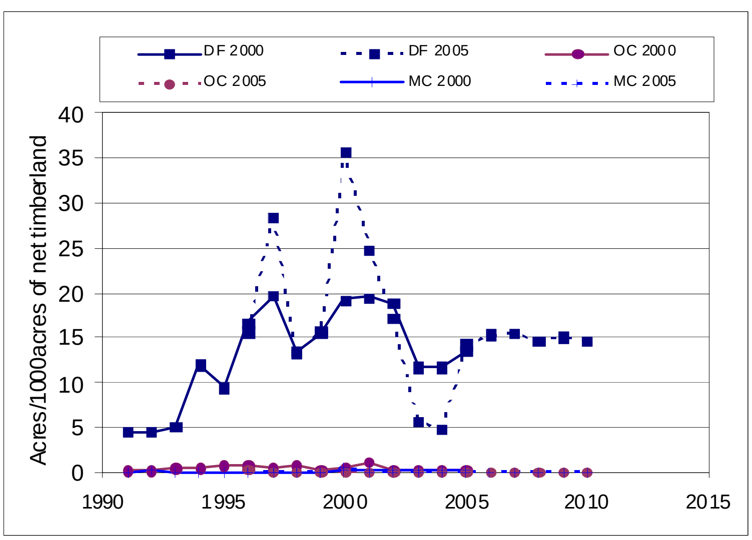
10.1 Fertilization Intensity, Acres/1000Acres of Net Timberland

2001 respondents reported a rapid increase from 5 to 20 A/1000A of net timberland between 1991 and 1997. The intensity fluctuated between 15 and 20A/1000A between 1998 and 2000. 2001 respondents also anticipated a level of about 15A/1000A in 2001-05.

2006 respondents reported wider swings from 1997 onward and project a level of about 15A/1000A in 2006-10. The species composition intensity for Douglas-fir, which accounts for almost all fertilization, is essentially the same as the total. At times fertilization has been done on small areas of other conifers and mixed conifers.

Figure 10.2 Fertilization Intensity, Acres/1000Acres of Net timberland. Douglas-fir (DF), mixed conifer (MC), other conifer (OC)



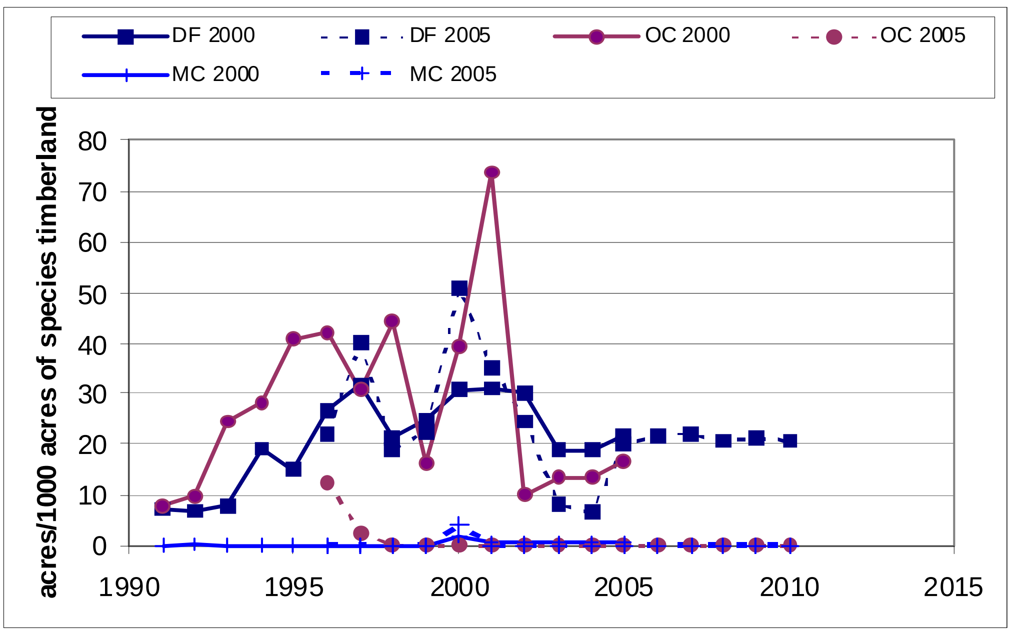


10.2 Acres/1000A of Species Net Timberland

A different perspective of each species is shown in Figure 10.3 by expressing fertilization intensity per 1000 acres of timberland of that species type. 2001 respondents reported that the intensity of fertilization on Douglas-fir land rose from 9A/1000A in 1991 to between 20 and 30A/1000A between 1997 and 2000; they anticipated that the intensity would remain in this range in the future. 2006 respondents a similar overall level of about 20A/1000A in 2006-10.

The situation for other conifers is strikingly different between the 2001 and 2006 respondents. 2001 respondents reported fertilization intensities on other conifer timberland that frequently exceeded intensities on Douglas-fir timberland but they projected a drop to 10-20A/1000A after 2001. In contrast, 2006 respondents indicate a much lower level between 1996 and 2000 and nearly zero thereafter. Very low activity has occurred, and is planned, in mixed conifers. None of the respondents fertilize hemlock or hardwood timberlands.

Figure 10.3 Fertilization Intensity, A/1000A of Species Timberland. Douglas-fir (DF), mixed conifer (MC), other conifer (OC)



10.3 Priority Stands for Fertilization

Respondents were asked to indicate their priorities for fertilizing combinations of age and site class for the different species. The priorities and corresponding numeric rank scores used to summarize the returns were high (3), medium (2), low (1), and not considered (0). The number of respondents indicating a priority was multiplied by the priority rank score and divided by the total number of responses to develop a mean score for each age/site class for each species.

Figure 10.4 summarizes the mean priority scores of the 2001 respondents. The overall scores are much higher for Douglas-fir followed by mixed conifers. Other conifers and hemlock received much lower scores. No priority data was obtained for fertilizing hardwoods. For Douglas fir, the highest priorities were for 21-50 year old stands on site classes II, III, and IV. The next highest priorities were for 21-50 year old Douglas-fir stands on site classe I and 0-20 year old Douglas-fir stands on site classes II, III, and IV. The next priority scores were for mixed conifers with a general preference pattern similar to that for Douglas-fir. Priorities for hemlock and other conifers were low.

Figure 10.4 Fertilization Priority Rankings of 2001 Respondents by Species, Age Class, and Site Class

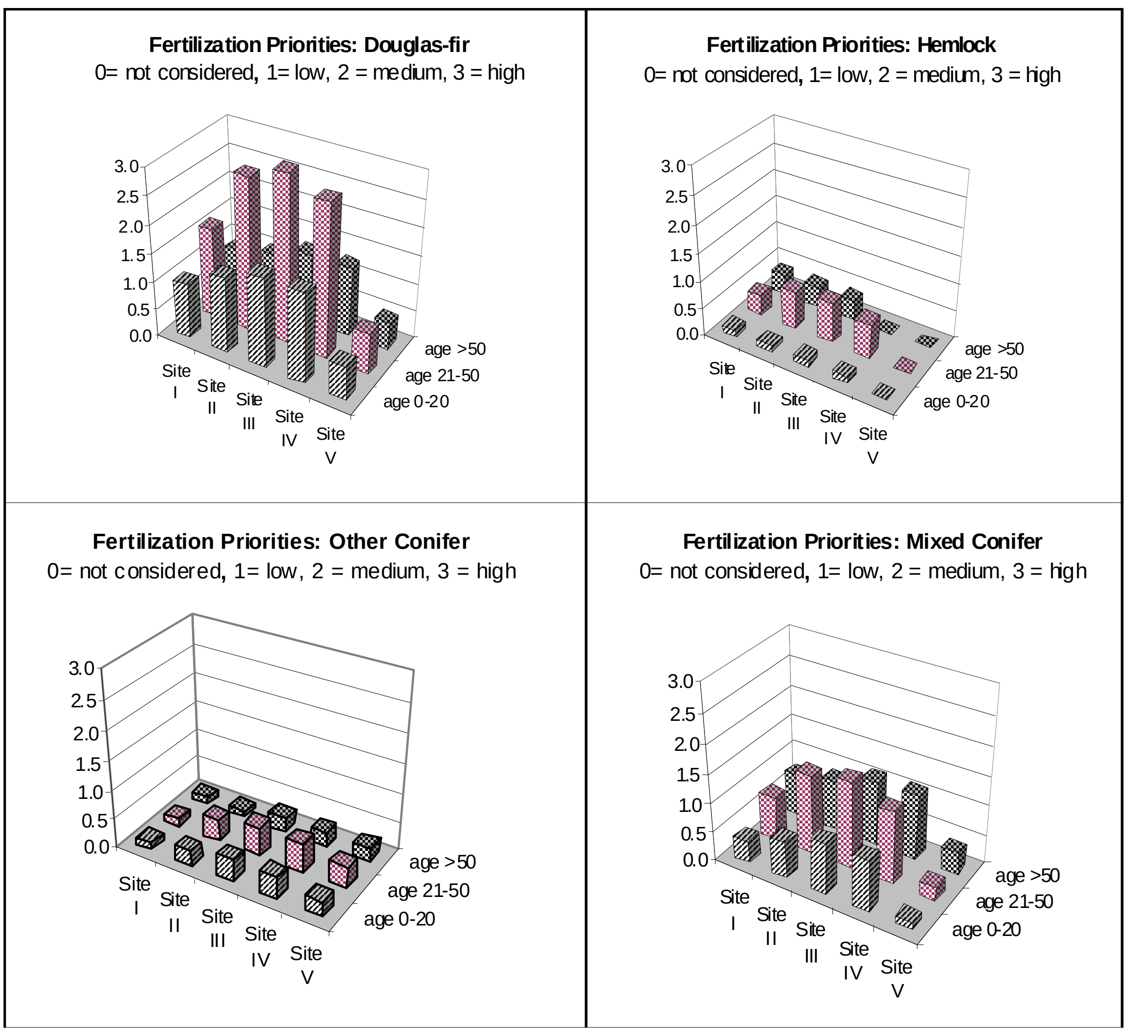
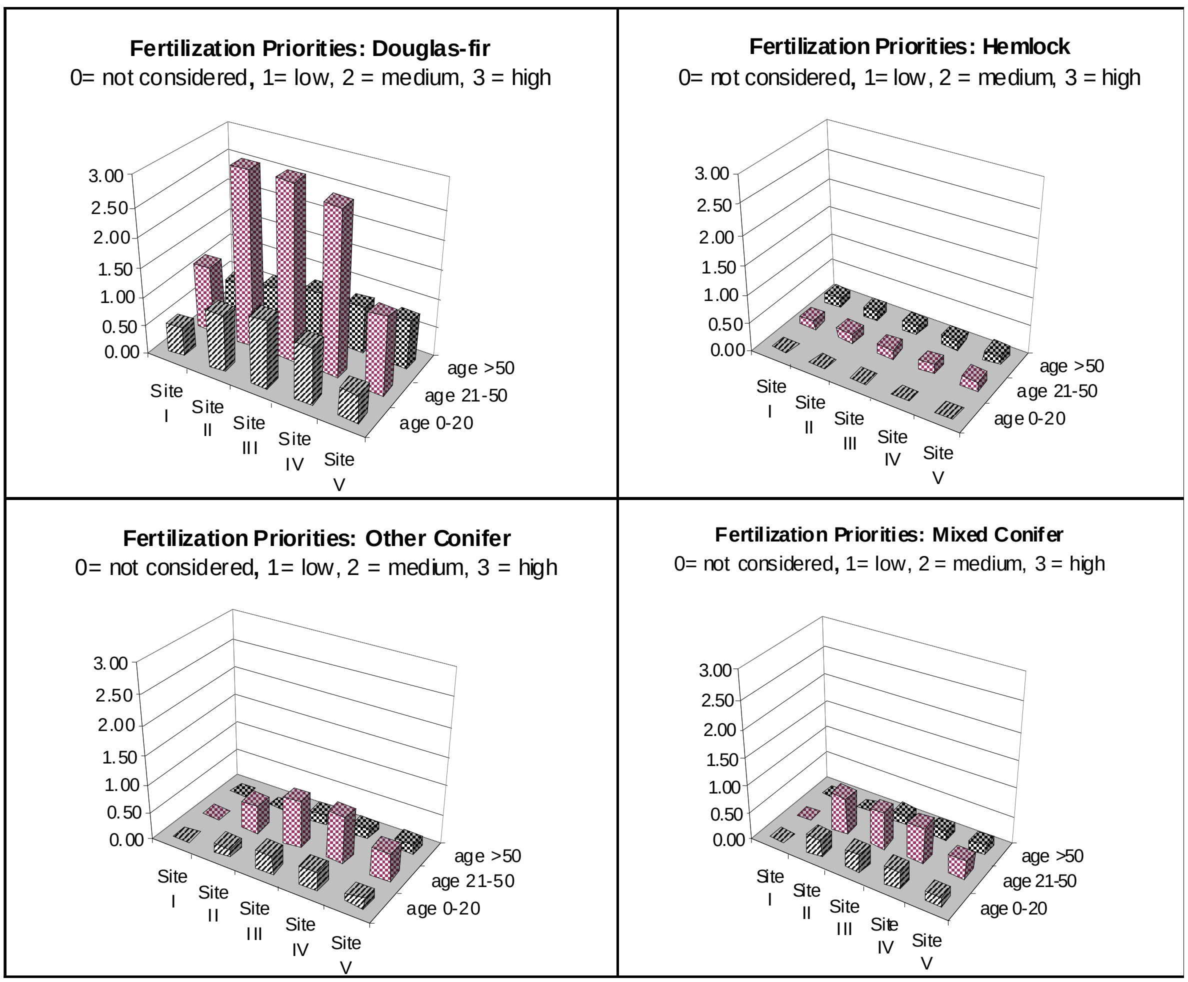


Figure 10.5 summarizes the mean priority scores of the 2006 respondents. Compared to the 2001 respondents, 2006 respondents indicate a much higher preference for fertilization of Douglas-fir, reduced interest in mixed conifers and hemlock, and little change for other conifers. For Douglas fir, the highest priorities are for 21-50 year old stands on site classe II, III, and IV. The next highest priorities are for 21-50 year old stands on site classes I and V, closely followed by 0-20 year old stands on site classes II, III, and IV. The priority scores for other conifers and mixed conifers are much lower than those for Douglas-fir but the overall patterns of emphasis are similar to the Douglas-fir patterns.

Figure 10.5 Fertilization Priority Rankings of 2006 Respondents by Species, Age Class, and Site Class



CHAPTER 11: PRUNING

Few respondents have conducted pruning and all pruning conducted since 1991 and planned for 2005-10 involves just Douglas-fir. Figures 11.1 and 11.2 present trends in pruning intensities per 1000A of total net timberland and per 1000A of Douglas-fir timberland. Since all pruning is Douglas-fir, the trend lines for the total and for Douglas-fir are the same in Figure 11.1 Activity rose from zero in 1991 to a high in 1996 and has dropped sharply since then. All pruning was done in a single lift to either 18 or 20 feet and the pruning trigger was total stand height between 30 and 40 feet.

Figure 11.1 Pruning Intensity, Acres/1000Acres of Net Timberland

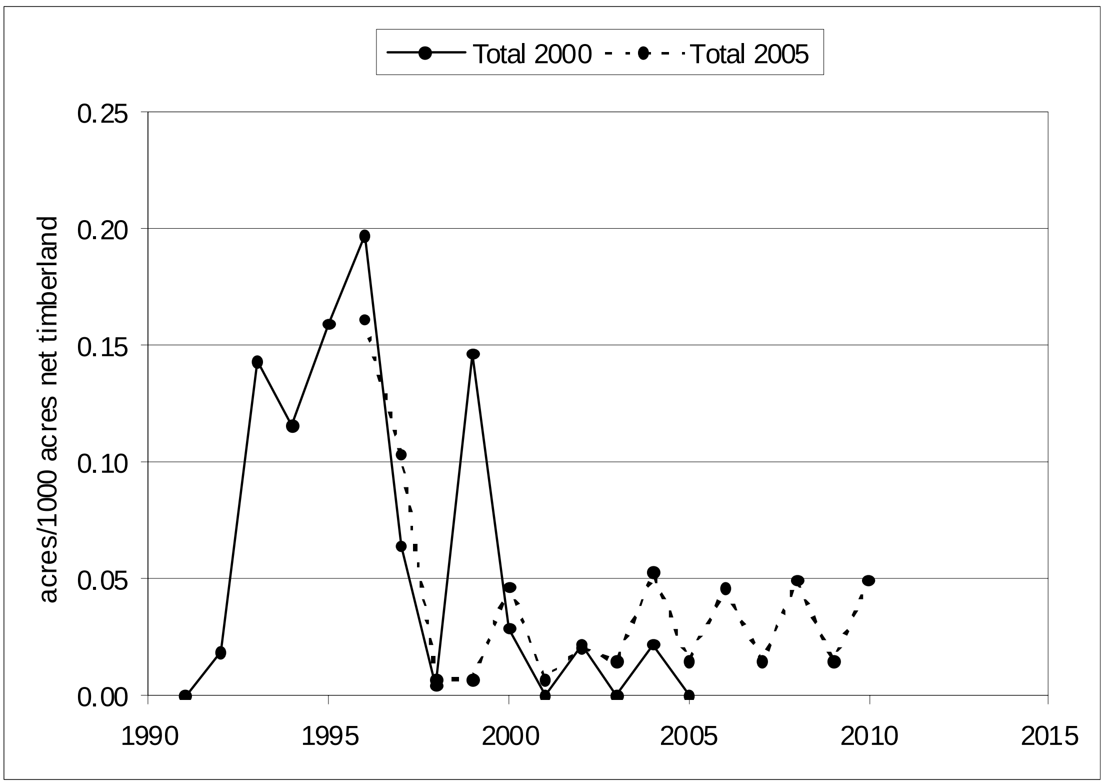
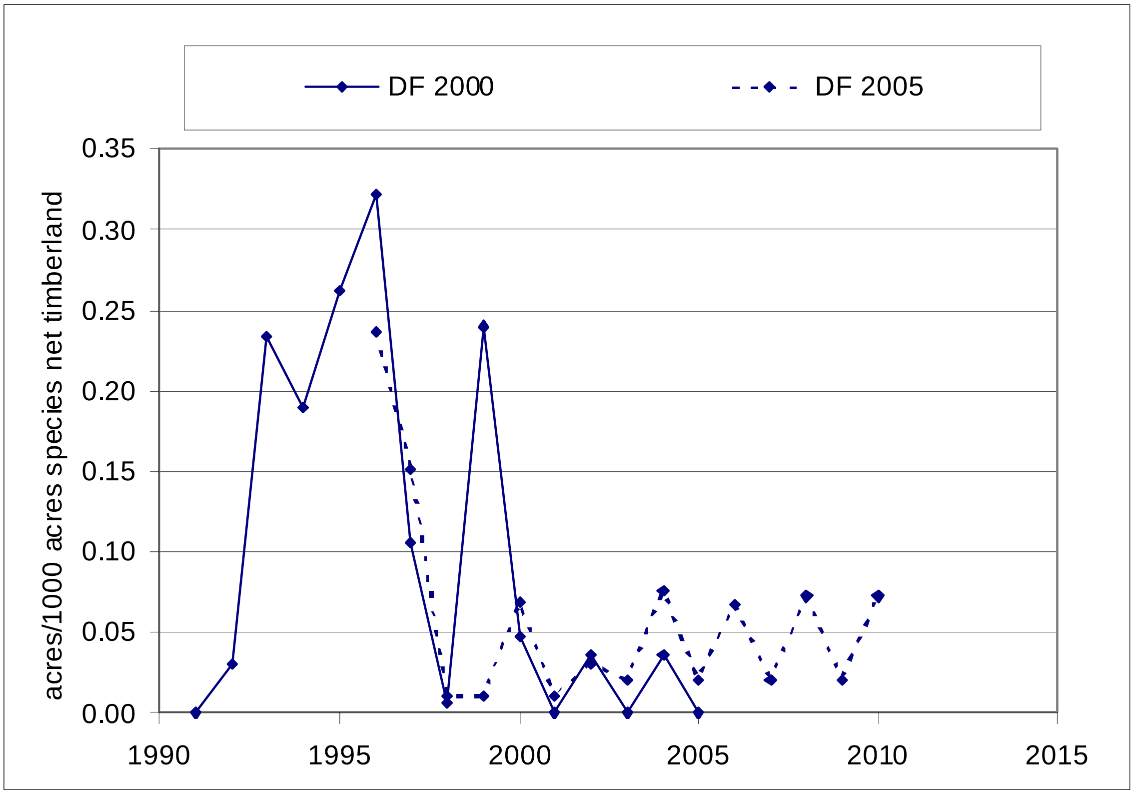


Figure 11.2 Pruning Intensity, Acres/1000 Acres of Species Net Timberland

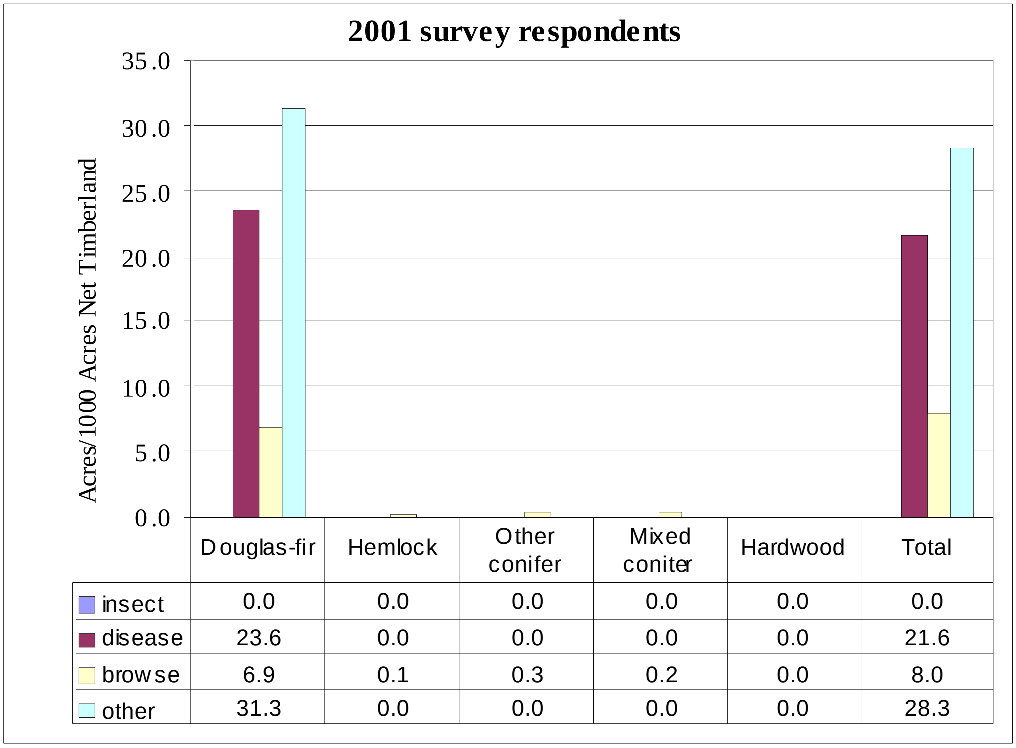


CHAPTER 12: PEST ISSUES

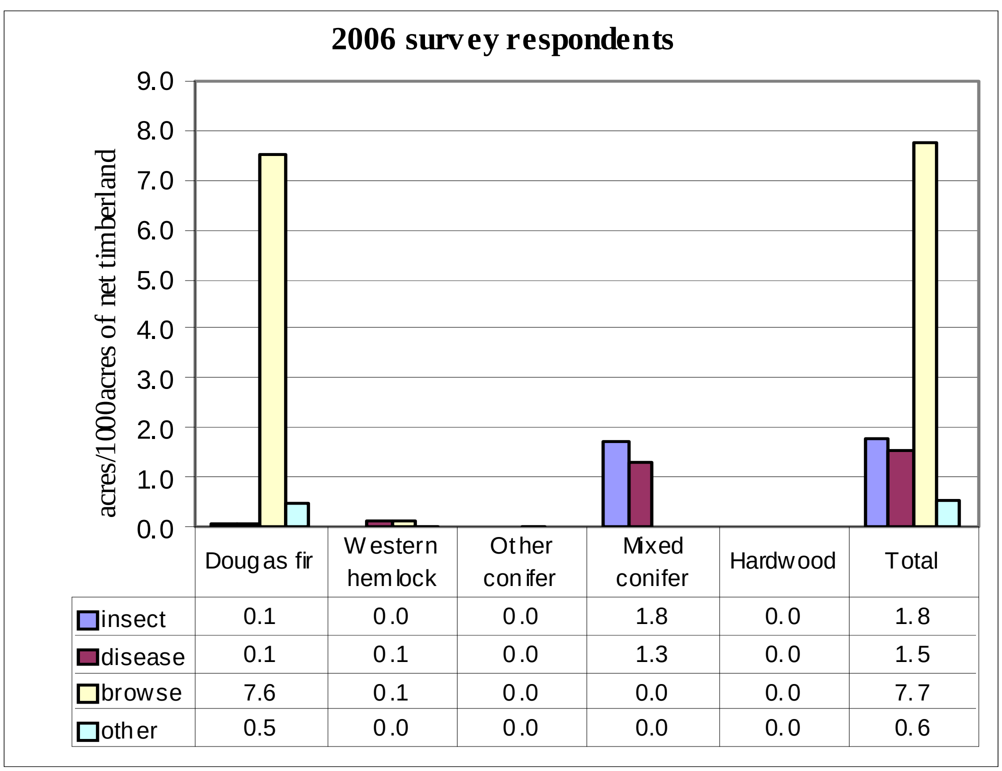
Respondents were asked to indicate the recent annual acres affected by various pests on net timberland. Figure 12.1 summarizes results per 1000 A of net timberland for the 2001 and 2006 respondents. Virtually all of the pest problems reported by 2001 respondents were associated with Douglas fir. Key issues were disease, 24A/1000A responses mainly citing Swiss needle cast and root rots. Browsing problems, 7A/1000A of responses, were mainly elk and deer. The “other” category of pest issues, 31A/1000A of responses, were predominantly mountain beaver and bear damage. No acreages associated with insect problems were given but the Douglas-fir bark beetle and seed eaters were mentioned as problems. Very low rates of browse damage, on the order of 1A/1000A were noted for hemlock, other conifer and mixed conifer stands.

The 2006 respondents indicate some shifts. First, the overall level is much lower due to major decreases in problems reported for disease and other types of pest damage in Douglas-fir. The drop in reported issues with disease in Douglas fir is very large; from 24 to less than 0.25A/1000A. Similarly, issues with other pests dropped from 31 to 0.5A/1000A. Issues with browse damage increased slightly from 6.9 to 7.6A/1000A. The other major changes were increased reports of pest issues in mixed conifers; from 0 to 1.8A/1000A for insect problems and from 0 to 1.3A/1000A for diseases.

Figure 12.1 Pest Management Acres/1000 Acres of Net Timberland



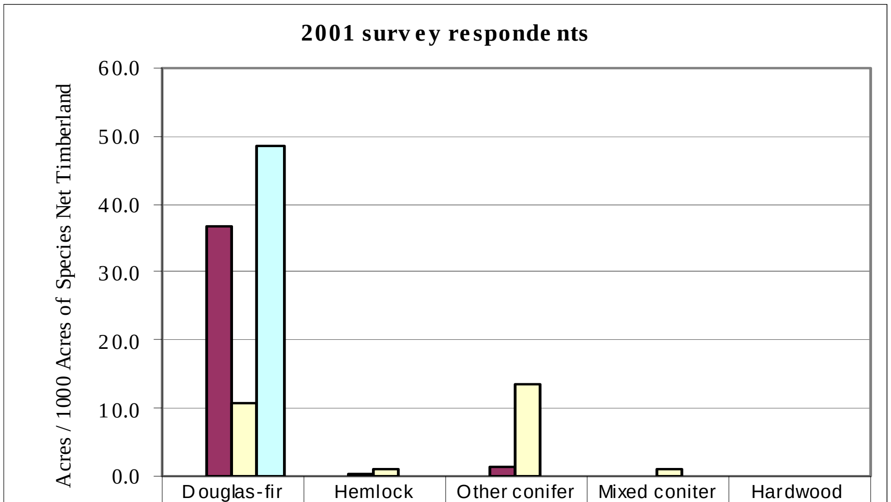
	Douglas-fir	Hemlock	Other conifer	Mixed conifer	Hardwood	Total
insect	0.0	0.0	0.0	0.0	0.0	0.0
disease	23.6	0.0	0.0	0.0	0.0	21.6
browse	6.9	0.1	0.3	0.2	0.0	8.0
other	31.3	0.0	0.0	0.0	0.0	28.3



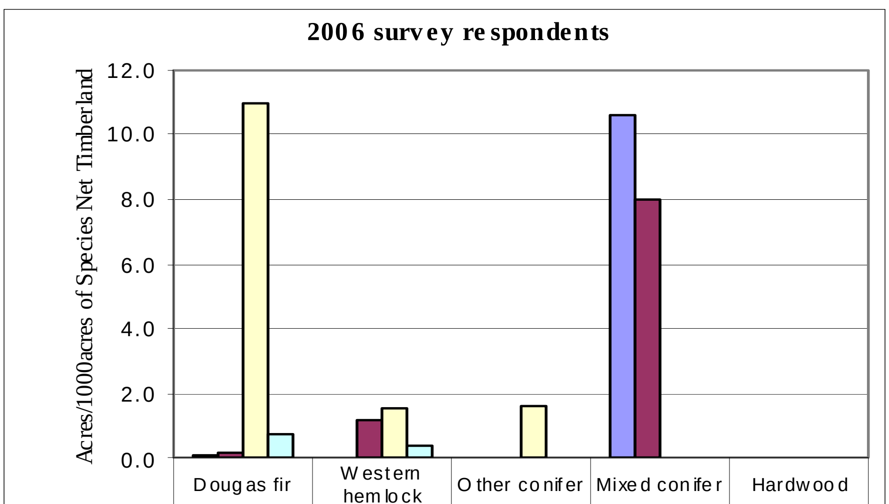
	Dougas fir	Western hemlock	Other conifer	Mixed conifer	Hardwood	Total
insect	0.1	0.0	0.0	1.8	0.0	1.8
disease	0.1	0.1	0.0	1.3	0.0	1.5
browse	7.6	0.1	0.0	0.0	0.0	7.7
other	0.5	0.0	0.0	0.0	0.0	0.6

Figure 12.2 re-casts the information in Figure 12.1 from A/1000A of net timberland to A/1000 A of the species net timberland type.

Figure 12.2 Pest Management, Acres/1000 Acres Species Net Timberland



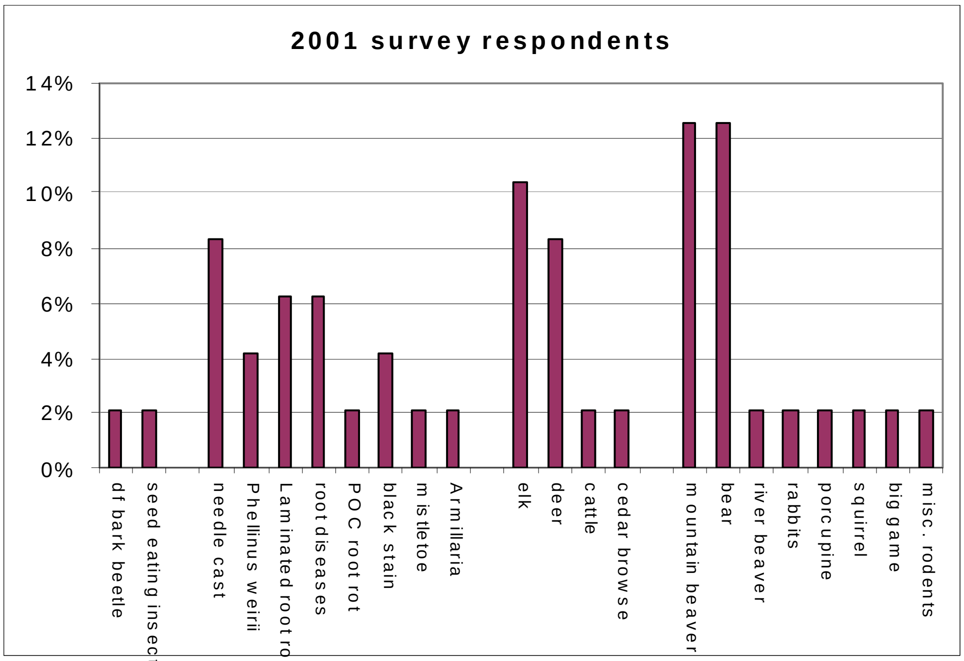
	Douglas-fir	Hemlock	Other conifer	Mixed coniter	Hardwood
insect	0.0	0.0	0.0	0.0	0.0
disease	36.7	0.3	1.2	0.0	0.0
browse	10.7	1.0	13.4	1.0	0.0
other	48.6	0.0	0.0	0.0	0.0

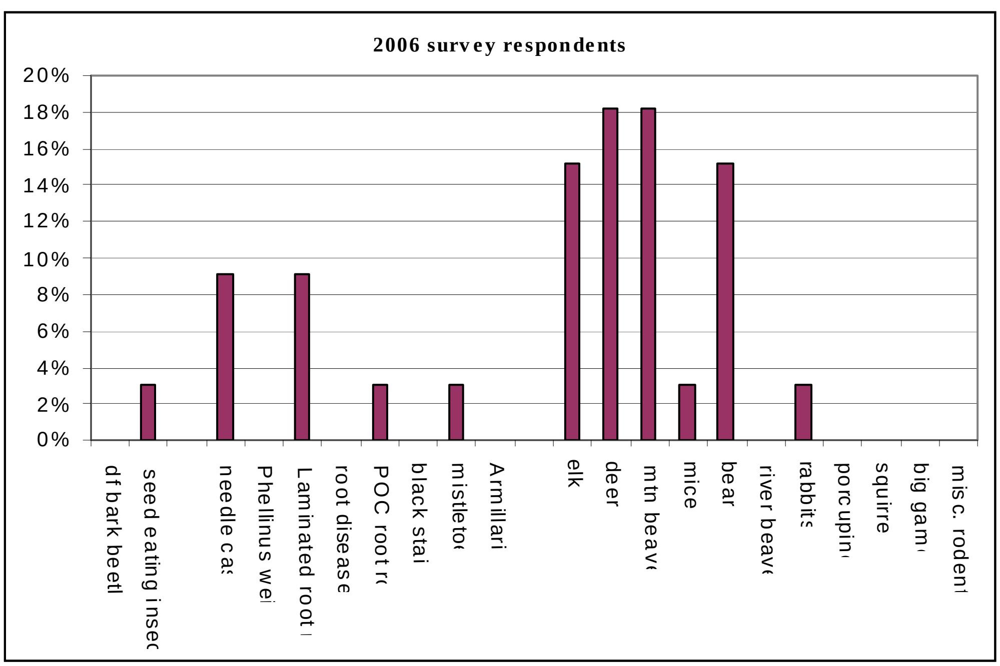


	Dougas fir	Western hemlock	Other conifer	Mixed conifer	Hardwood
insect	0.1	0.0	0.0	10.6	0.0
disease	0.1	1.2	0.0	8.0	0.0
browse	10.9	1.6	1.7	0.0	0.0
other	0.7	0.4	0.0	0.0	0.0

Figure 12.3 indicates the frequency with which various pest organisms were cited as problems by the respondents to the surveys. The top four pests in both surveys are mammals, (bear, deer, elk and mountain beaver), followed by Swiss needle-cast.

Figure 12.3 Frequency of Pest Issues



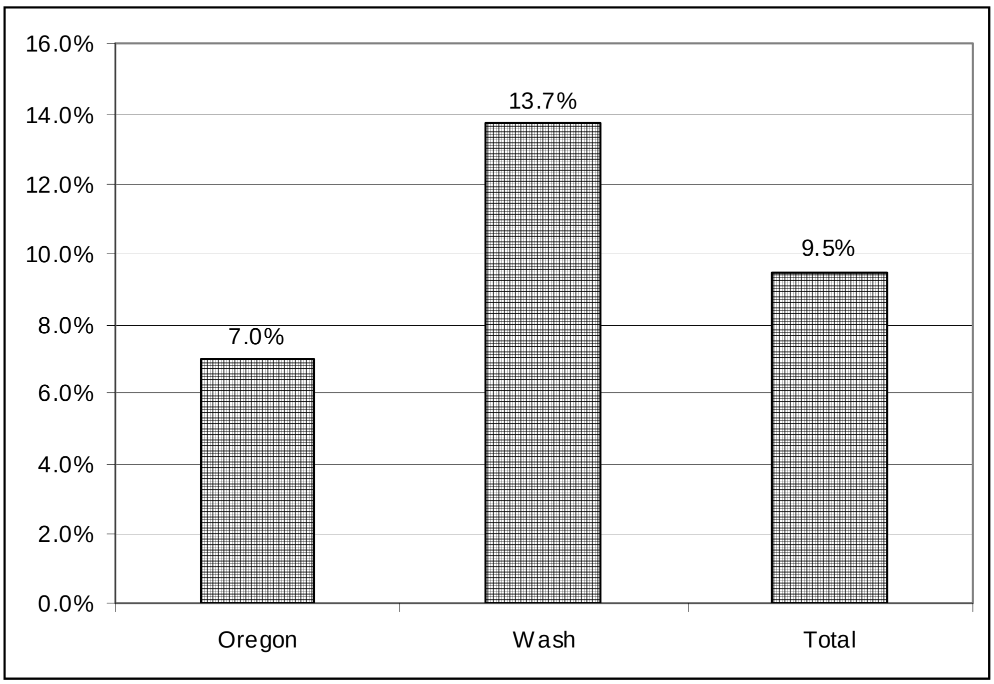


CAPTER 13: FOREST REGULATIONS

13.1 Operable Net Timberlands

The reduction from gross to net timberland in Figure 2.1 reflects reflect land occupied by rock outcrops, wetlands, and otherwise incapable of producing at least 20 cubic feet per acre per year. Respondents were asked to indicate the percentage reduction of net timberland associated with roads and other infrastructure and constraints on use due to regulations and other factors. Figure 13.1 indicates that 2001 respondents reported that the reduction for all reasons was 7.0% in Oregon, 13.7% in Washington, and 9.5% overall.

Figure 13.1. Unmanaged Net Timberland, % by State, 2001 respondents



2006 respondents were asked to provide this information with further detail to identify sources of the reductions. Figure 13.2 indicates that the reduction for all reasons was 9.6% in Oregon, 14.1% in Washington, and 11.4% overall. In general more net timberland has been placed in inoperable or constrained use since 2001 for both states. Figure 13.3 provides the distribution of reasons for these reductions given by the 2006 respondents.. There is little difference between the states in the component of inoperable net timberland due to roads which averaged 27%. However, there are large differences between the states in inoperable net timberland due to riparian area restrictions (40% in Oregon, 63% in Washington and 51% combined), habitat reserves (30% in Oregon, nearly 0% in Washington and 15% combined), and other regulatory effects (3% in Oregon, 11% in Washington and 7% combined). Reduction of net timberland associated with voluntary reserves was very small.

Figure 13.2. Unmanaged Net Timberland, % by State, 2006 respondents

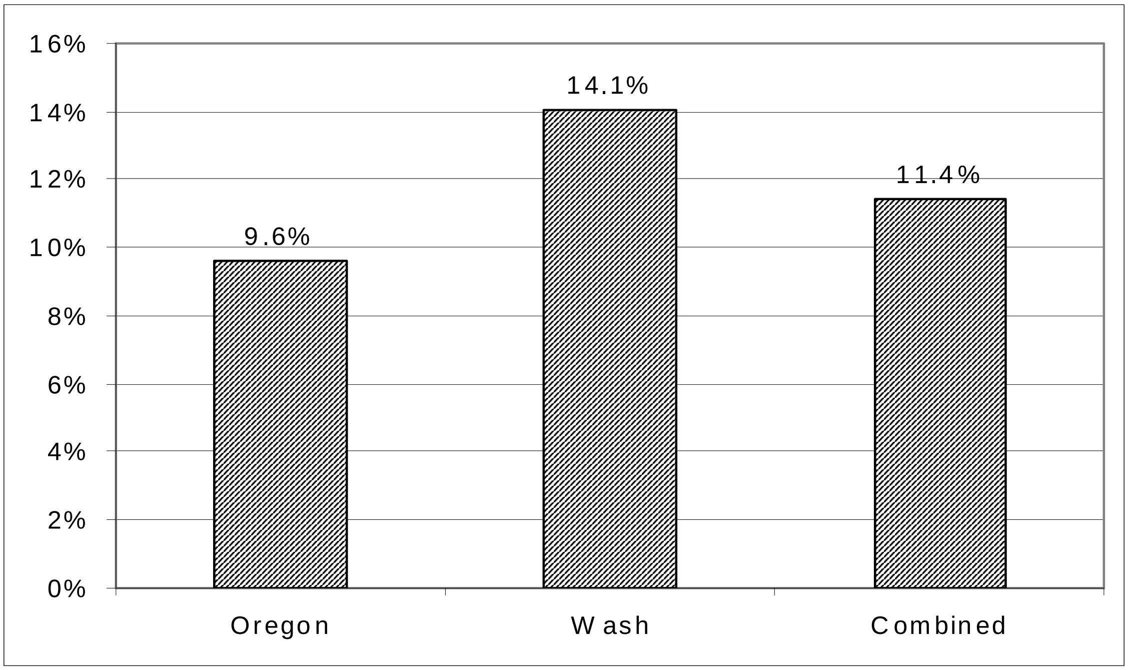
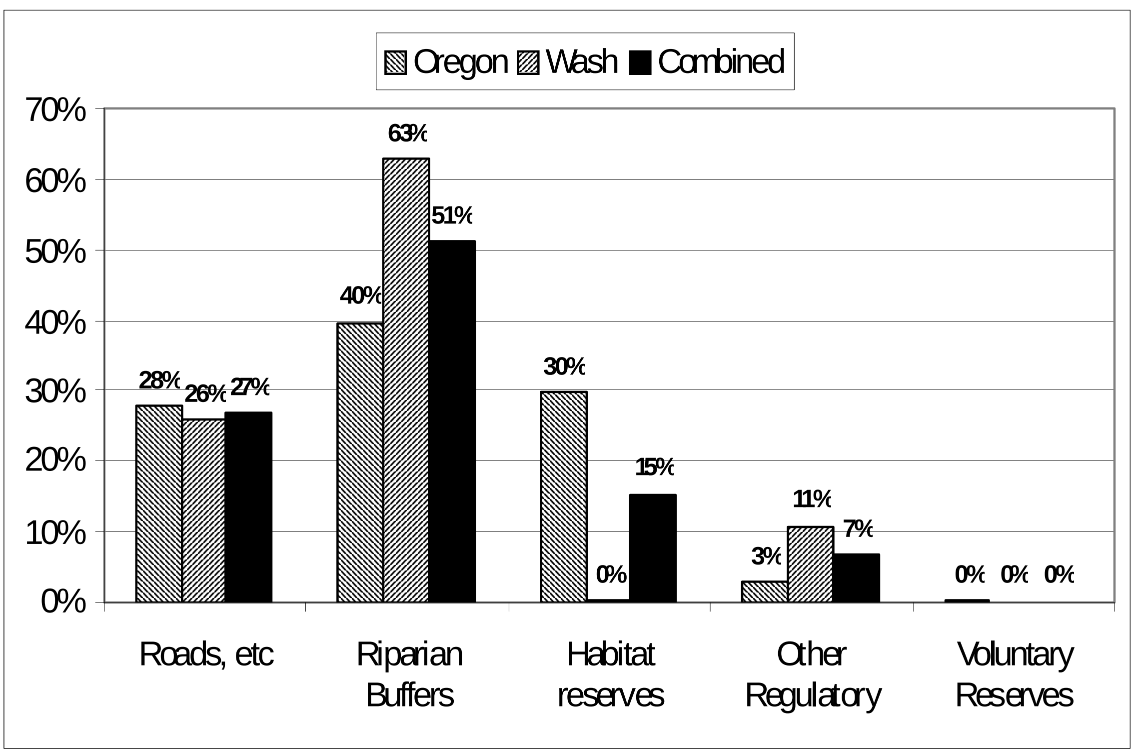


Figure 13.3 Reasons for Unmanaged Net Timberland, by State



13.2 Process to Identify Soil Disturbance/Compaction Due to Ground-based Harvest Systems

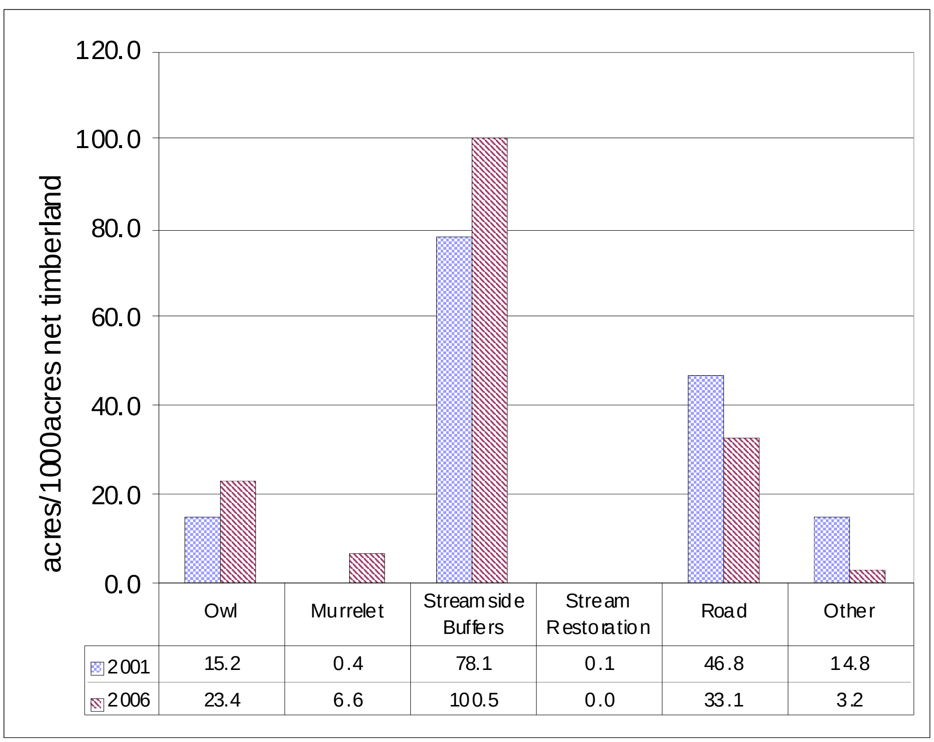
Respondents were asked to indicate if they presently have a process in place to identify areas harvested with ground-based systems that have had soil disturbance and compaction requiring tillage or other treatments. All respondents to each survey answered this question; 44% of the 2001 respondents and 50% of the 2006 respondents indicated that they have such a process.

13.2 Acreages Affected by Regulations

Respondents were asked to indicated the acreage affected by regulations for endangered species, stream protection and restoration, restoration associated with roads, and other environmental protections. They were also asked to indicate the effect of these regulations on rotation length and to indicate the additional cost per acre associated with planning and management associated with these regulations. Six of the 2001 respondents and five of the 2006 respondents provided data.

Figure 13.4 summarizes the acreage falling under various regulatory categories, expresses as acres per 1000 A of net timberland. Acreage affected by streamside buffers, spotted owl and marbled murrelet all increased. Road restoration decreased, perhaps reflecting prior work that has removed some of the inventory of roads to be restored.

Figure 13.4 Impact of Regulatory and Other Set-Asides, Acres per 1000 Acres of Net Timberland



	Owl	Murrelet	Streamside Buffers	Stream Restoration	Road	Other
2001	15.2	0.4	78.1	0.1	46.8	14.8
2006	23.4	6.6	100.5	0.0	33.1	3.2

13.3 Costs and Effect on Rotation Length

For spotted owl and murrelet protection and stream buffers, the effect on rotation was considered to be indeterminate in the sense that these protection zones often have restrictions on tree harvesting or a "no cut" requirement that renders the concept of a conventional rotation or harvest cycle meaningless. In cases where dispersal habitat is being created, rotation may increase in some stands and decrease in others to achieve desired effects. Road and stream restoration were not viewed as having any effect on rotation.

Few provided estimates of per acre costs associated with these protection and restoration activities. Table 13.1 indicates the wide range of per acre costs from this small sample. Some respondents commented on the difficulty of separating these costs from "normal" operational costs. The wide cost range may be indicative of very different conditions on different ownerships and/or differences in cost accounting where some indicate direct costs and others indicate direct plus indirect costs. Then cost ranges in Table 13.1 should be treated with caution; this is an area that requires further investigation.

Table 13.1 Cost of Regulations, $/Acre

	2001 Survey	**2006 Survey**
Spotted owl, marbled murrelet	$0.05 - $25.00	$0.25 - $26.00
Streamside buffers	$1.00 – $10.00	$0.05 – $10.00
Road restoration, drainage improvement	$0.70-$130.00	$0.20-$2500.00

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STAND MANAGEMENT COOPERATIVE OWNER SURVEY # 6

STATUS OF STAND MANAGEMENT IN PACIFIC NORTHWEST WEST-SIDE FORESTS

In 1983, 1986, 1991, 1996, and 2001 a survey has been sent to SMC members concerning their timberland base and silvicultural practices. A summary of the last survey can be found in:

Briggs, David, John Trobaugh. 2001. Management Practices on Pacific Northwest West-side Industrial Forest Lands: 1991-2001 with Projections to 2005. Working Paper 2. Stand Management Cooperative. College of Forest Resources, University of Washington, Seattle, WA. 65pp.

Enclosed is the new 2006 survey to update this series of important information. With a few minor changes, it gathers the same information as the 2001 survey. If you completed the 2001survey, I could send or FAX a copy if that would be helpful in filling out the new survey. **All survey information from organizations will be kept strictly confidential; only aggregate summary results will be released or published.**

This new survey will be very timely since, in 2005, the Washington State Legislature asked the UW College of Forest Resources to prepare a comprehensive analysis on the future of the state's forests. A final report will be completed by the end of 2007. The report's research results and policy recommendations will provide input to policy decisions at the state and local levels and serve as a framework for public forums that will also help shape forest policy. Washington's forest industry owns 29% of the state's timberlands and provides 60% of the annual timber harvest volume. A critical element of an examination of Washington's forest lands will be an understanding of current and expected forest management practices. The previous SMC survey has been widely used for developing management regimes and associated costs for west-side industrial forests that are used in growth and yield models to simulate various forest treatments and assess results; the new survey can be very helpful in updating and refining the information on management practices and costs.

Please return the completed survey by **June 1, 2007**. I wish to thank you for your participation.

Sincerely,

David Briggs
Director, Stand Management Cooperative

In case we have a question regarding your completed form, please supply the following information

ORGANIZATION ____

INFORMATION SUPPLIED BY ____

DATE _________________ TELEPHONE________________________

FAX___________________ EMAIL _____________________________

A. TIMBERLAND BASE

1. Ownership of timberland west of the Cascade Crest.

	Gross Timber land	Net Timber land[1]	% of Net Timberland placed in				
	Acres	Acres	Roads & infra-structure, %	Constrained Mgt due to Regulations			Voluntary Reserves, %
				Riparian Buffers, %	Habitat Reserves, %	Other %	
British Columbia							
Oregon							
Washington							
Total							

[1] capable of producing at least 20 ft^3 per acre per year

Note: Your Net Timberland acres are the basis for subsequent questions.

2. How would you characterize your Net Timberland in terms of forest type? Please ensure that the total equals 100%.

Douglas-fir	__________ %
Western hemlock	__________ %
Douglas-fir / western hemlock	__________ %
True fir / mountain hemlock	__________ %
Other conifer	__________ %
Hardwoods	__________ %
Non-stocked	__________ %
Total	**100 %**

3. How would you characterize your Net Timberland by generalized site classes (SI_{50}). Please indicate the King's Site Index range for each class and ensure that the total equals 100%.

Site Class	Site Index (SI_{50}) Range	% of Net Timberland
I	>= 135	
II	115-134	
III	95-114	
IV	75-94	
V	<= 74	
Total		**100 %**

B. REGENERATION PRACTICES

4. What is the average size of a regeneration unit? __________ acres.

5. What percentage of timberland reforested in the past 5 years was

a. planted with seedling stock ? ___________ %
b. seeded or naturally regenerated? ___________ %

6. How many acres has your organization regenerated in the past 10 years and planned for the next 5 years?

Year	Douglas-fir, acres	W. hemlock, acres	Other conifer, acres	Mixed Conifer, acres	Hardwoods, acres	Total, Acres
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
Plan:						
2006						
2007						
2008						
2009						
2010						

7. For each species indicated, what is the predominant stock type you are planting and what is the target stocking level?

Species	Preferred Stock Type(s)	Desired Planting Density, trees per acre	Desired Density at age 10, trees per acre
Douglas-fir			
Western hemlock			
Other conifer			
Hardwoods			

8. Please indicate the planting cost/acre (exclusive of seedling cost) for the appropriate density.

Spacing ➔ Trees/acre ➔	6x6 1210	8x8 680	9x9 540	10x10 440	11x11 360	12x12 300	15x15 200	21x21 100	Other (please specify)
Minimum, $/acre									
Maximum, $/acre									
Average, $/acre									

9. **For <u>Douglas-fir</u>, please indicate the number of seedlings planted in the last 10 years and planned for the next 5 years with the indicated stock types.**

Year	1 + 1 transplants	P + 1 transplants	Small plugs (<=S-8* or equivalent)	Large plugs (>S-8 or equivalent)	Other
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
Plan:					
2006					
2007					
2008					
2009					
2010					

* S-8 aka 415C aka 91/130

10. **For <u>Western hemlock</u>, please indicate the number of seedlings planted in the last 10 years and planned for the next 5 years with the indicated stock types.**

Year	1 + 1 transplants	P + 1 transplants	Small plugs (<=S-8 or equivalent)	Large plugs (>S-8 or equivalent)	Other
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
Plan:					
2006					
2007					
2008					
2009					
2010					

11. For Cedar, please indicate the number of seedlings planted in the last 10 years and planned for the next 5 years with the indicated stock types.

Year	1 + 1 transplants	P + 1 transplants	Small plugs (<=S-8 or equivalent)	Large plugs (>S-8 or equivalent)	Other
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
Plan:					
2006					
2007					
2008					
2009					
2010					

12. For Other Conifers, please indicate the number of seedlings planted in the last 10 years and planned for the next 5 years with the indicated stock types.

Year	1 + 1 transplants	P + 1 transplants	Small plugs (<=S-8 or equivalent)	Large plugs (>S-8 or equivalent)	Other
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
Plan:					
2006					
2007					
2008					
2009					
2010					

13. For Red Alder, please indicate the number of seedlings planted in the last 10 years and planned for the next 5 years with the indicated stock types.

Year	1 + 1 transplants	P + 1 transplants	Small plugs (<=S-8 or equivalent)	Large plugs (>S-8 or equivalent)	Other
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
Plan:					
2006					
2007					
2008					
2009					
2010					

C. SITE PREPARATION

14. Acres of Site Preparation west of the cascades in the last 10 years and planned for the next 5 years.

Year	Douglas-fir, acres	W. hemlock, acres	Other conifer, acres	Mixed Conifer, acres	Hardwoods, acres	Total, Acres
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
Plan:						
2006						
2007						
2008						
2009						
2010						

15. Acres of Site Preparation Treatments west of the cascades in the last 10 years and planned for the next 5 years. (Since an acre may get more than one treatment in a year, the acres in each year in this table may exceed the acres in the same year in Question 13). <u>For chemical site preparation indicate the total acres treated and the percentage of these acres treated with a pre-emergent herbicide to control herbaceous weeds in the first growing season after planting.</u>

Year	Broadcast Burn, acres	Pile and Burn, acres	Chemical Site Preparation Acres	% with pre-emergent	Mechanical Only, acres	No Treatment, acres
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
Plan:						
2006						
2007						
2008						
2009						
2010						

16. Current cost information for site preparation treatments

	Minimum, $/Acre	Maximum, $/Acre	Average, $/Acre
Broadcast burn			
Pile and burn			
Chemical site prep.			
Other (please state)			

D. VEGETATION CONTROL AFTER PLANTING

17. Post-planting vegetation management west of the cascades in the last 10 years and planned for the next 5 years.

Year	Douglas-fir, acres	W. hemlock, acres	Other conifer, acres	Mixed Conifer, acres	Hardwoods, acres	Total, Acres
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
Plan:						
2006						
2007						
2008						
2009						
2010						

18. Acreage of Post-Planting Vegetation Control Treatments west of the cascades in the last 10 years and planned for the next 5 years. (Since an acre may get more than one treatment in a year, the acres in each year in this table may exceed the acres in the same year in Question 16)

Year	1st Year herbaceous Control, acres	2nd Year herbaceous Control, acres	Woody Release, acres	Other (please specify), acres	Total, acres
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
Plan:					
2006					
2007					
2008					
2009					
2010					

19. Current cost information for vegetation control

	Minimum, $/Acre	Maximum, $/Acre	Average, $/Acre
1st year herbaceous			
2nd year herbaceous			
Woody release			

E. STAND DENSITY MANAGEMENT

20. Total acres pre-commercially thinned west of the cascades in the last 10 years and planned for the next 5 years.

Year	Douglas-fir, acres	W. hemlock, acres	Other conifer, acres	Mixed Conifer, acres	Hardwoods, acres	Total, Acres
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
Plan:						
2006						
2007						
2008						
2009						
2010						

21. Total acres commercially thinned west of the cascades in the last 10 years and planned for the next 5 years.

Year	Douglas-fir, acres	W. hemlock, acres	Other conifer, acres	Mixed Conifer, acres	Hardwoods, acres	Total, Acres
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
Plan:						
2006						
2007						
2008						
2009						
2010						

22. What percentage of total harvest volume is from commercial thinning operations?
__________ %

23. Current cost information for thinning operations (cost for commercial thinning should be to roadside)

	Minimum, $/Acre	Maximum, $/Acre	Average, $/Acre
Precommercial thin			
Commerial thin			

E. PRUNING

24. Total acres pruned west of the cascades in the last 10 years and planned for the next 5 years.

Year	Douglas-fir, acres	W. hemlock, acres	Other conifer, acres	Mixed Conifer, acres	Hardwoods, acres	Total, Acres
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
Plan:						
2006						
2007						
2008						
2009						
2010						

25. Pruning Prescription

	Douglas-fir	W. hemlock	Other conifer	Hardwoods
Single lift ?				
Multiple lift ?				
Final pruned height				
Trigger for initial prune is				

26. Current or most recent cost for pruning to final height:

	Minimum	Maximum	Average
Per acre			
Per tree			

F. FFERTTILIZATION

27. Total acres fertilized west of the cascades in the last 10 years and planned for the next 5 years.

Year	Douglas-fir, acres	W. hemlock, acres	Other conifer, acres	Mixed Conifer, acres	Hardwoods, acres	Total, Acres
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
Plan:						
2006						
2007						
2008						
2009						
2010						

28. Fertilization Priorities. For each species, fill in each cell with one of the following codes to indicate which age and site classes have fertilization priority

H = high priority
M = medium priority
L = low priority
N = not considered for fertilization

a. Douglas-fir

	Age 0-20	Age 21-50	Age > 50
Site Class I			
Site Class II			
Site Class III			
Site Class IV			
Site Class V			

b. Western hemlock

	Age 0-20	Age 21-50	Age > 50
Site Class I			
Site Class II			
Site Class III			
Site Class IV			
Site Class V			

a. Other conifer

	Age 0-20	Age 21-50	Age > 50
Site Class I			
Site Class II			
Site Class III			
Site Class IV			
Site Class V			

b. Mixed conifer

	Age 0-20	Age 21-50	Age > 50
Site Class I			
Site Class II			
Site Class III			
Site Class IV			
Site Class V			

c. Hardwoods

	Age 0-20	Age 21-50	Age > 50
Site Class I			
Site Class II			
Site Class III			
Site Class IV			
Site Class V			

29. Fertilization Prescription(s)

	Douglas-fir	W. hemlock	Other conifer	Mixed conifer	Hardwoods
Nutrient					
Source					
Rate, lb/acre					

Example: Nutrient is N, source is urea, rate is 200 lb/acre

30. Current cost information for fertilization operations

	Minimum, $/Acre	**Maximum, $/Acre**	**Average, $/Acre**
Fertilization			

G. INSECT, DISEASE, & WILDLIFE

31. How many acres are planned to include the following practices?

Practice	Douglas-fir, acres	Western hemlock, acres	Other Confer, acres	Mixed Conifer, acres	Hardwoods, acres	Total, acres
Insect Control						
Disease control						
Browse						
Other, please specify						

a. What insect(s) are the main concerns in your control program?

____
____
____

b. What disease(s) are the main concerns in your control program?

____
____
____

c. What browsing problem(s) are the main concerns in your control program?

____
____
____

d. What other items are concerns in your control program?

____
____
____

H. HARVEST UNIT SIZE & ROTATION

32. How has the size of harvest/regeneration units changed? Please indicate the minimum, maximum, and average unit size for the indicated years.

Year	Minimum, acres	Maximum, acres	Average, acres
1995			
2000			
2005			

33. Under normal conditions, what is the expected rotation length by site class for regenerated stands of the following species?

Site Class	Douglas-fir	W. hemlock	Other conifer	Mixed Conifer	Hardwoods
Site Class I					
Site Class II					
Site Class III					
Site Class IV					
Site Class V					

34. What effect does each of the following cultural practices have on rotation length?

Practice	*No change*	Increases rotation	Decreases rotation
Wide planting density			
Pruning			
Fertilization			
Other, please specify			

35. What percentage of the area harvested/regenerated in the last 5 years and projected for the next 5 years have included or will include the following practices?

Practice, %	**2001-2005**	**2006-2001**
Whole tree logging		
Yarding unmerchantable material		
Woody material/snag creation or maintenance		
Variable retention thinning or harvests (green tree retention)		
Species conversion		
Other, please specify		

36. Do you have a process in place to identify ground-based harvest areas that have been compacted / disturbed so that areas in need of amelioration receive tillage or other treatments? (Check one)

☐ **Yes** ☐ **No**

37. **For each following regulatory factors, please indicate the acreage affected on your lands, impact on rotation length on these specially managed acres, and the associated increase in planning and management costs on these acres ($ per acre)**

Regulatory Issue	Additional Acres affected	New rotation length, years	Increase in Planning & Management Cost ($ / Acre)
Northern spotted owl			
Marbled murrelet			
Streamside buffers			
Stream restoration (add wood debris, special plantings, etc.)			
Road/drainage restoration			
Other, please specify			

J. COMMENTS

Please make any additions, comments, or clarifications regarding any section of this survey. Thank you for your assistance in completing this survey.