June 1999

HSC

Hardwood Silviculture Cooperative

1998-1999

Annual Report

Oregon State University
College of Forestry

STAFF

David E. Hibbs

Professor
Program Leader

Alison Luckett Bower

Senior Faculty Research Assistant

Department of Forest Science

College of Forestry

301F Richardson Hall

Oregon State University

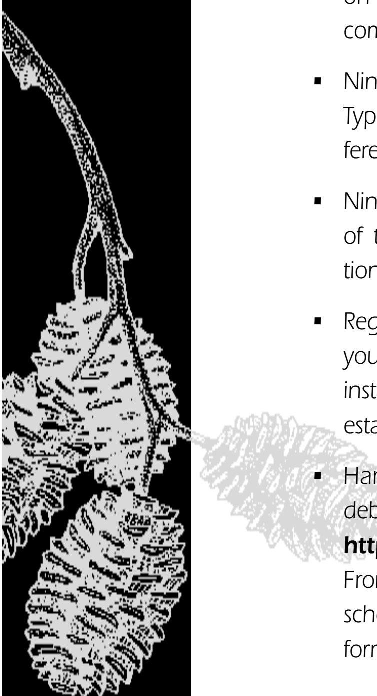
Corvallis OR 97331-5752

(541) 737-6100

Hardwood
Silviculture
Cooperative

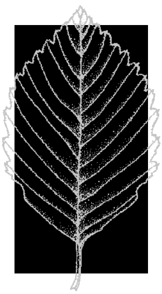
1998-1999 Annual Report

HIGHLIGHTS OF 1998-1999



- Regeneration surveys were completed on the 2 youngest Type 2 (variable density) installations. All twenty-six Type 2 installation are well into the treatment phase of the Red Alder Stand Management Study.
- The first thinning treatment (3-5 year thin) was completed on five Type 2 installations, bringing the total of installations having their first thinning treatment to 14.
- The second thinning treatment (15-20′ height to live crown thin) was completed on four Type 2 installations. This brings the total of installations on which two thinning treatments have been completed to 8.
- Nine-year measurement were completed on three Type 2 installations, and we are seeing strong differences in growth between treatment regimes.
- Nine-year measurement were completed on two of the four Type 1 (natural alder stand) installations.
- Regeneration surveys were completed on the 2 youngest Type 3 (mixed red alder/ Douglas-fir) installations. All seven Type 3 installation are well established.
- Hardwood Silviculture Cooperative web-page debuted in October 1998, at
  http://www.cof.orst.edu/coops/hsc
  From here members can download the manual, schedule for field work, and other pertinent information.

Contents



Introduction

The Hardwood Silviculture Cooperative (HSC) conducts research on the silviculture of red alder (*Alnus rubra*) and mixes of alder and Douglas-fir (*Pseudotsuga menziesii*) in the Pacific Northwest. The goal of the Cooperative is to improve the management and production of red alder. Towards this goal, the HSC has developed the Red Alder Stand Management Study which evaluates management regimes under varied site qualities and conditions, as well as varied management objectives.

The HSC came together in 1988 as a combination of industry and both federal and state agency members, each with its own reasons for pursuing red alder management. For instance, industry wants to grow alder for high-quality saw logs, while the USDA Forest Service wants to manage red alder as a component of bio-diversity. What members have in common is that they all want to grow red alder to meet their specific objectives.

The HSC's highest priority is to understand the response of red alder to spacing in plantations. To accomplish this, the Cooperative has installed 26 variable density plantations. The plantation distribution covers a wide range of geographic conditions and site qualities. At each site, cooperators planted large blocks at densities of 100, 250, 525, and 1200 trees per acre. Each block is subdivided into several treatments covering a range of thinning and pruning options.

In addition to the 26 variable-density plantations, the Cooperative has related studies in four naturally regenerated stands and seven planted mixed alder/Douglas-fir stands. Naturally regenerated stands up to 15 years old and 5 to 10 acres in size were sought as a means of short-cutting some of the growing lag time before meaningful thinning results could be obtained from the plantations.

The seven mixed plantations of alder and Douglas-fir are new plantations. They are located on ground designated as Douglas-fir site class III or below. These low site qualities are often a result of nitrogen deficient soils. Each site is planted at 300 trees per acre with four proportions of the two species. The site layout is designed to look at the interactions between the two species. We expect to find that in low proportions, alder can benefit the Douglas-fir when soil nitrogen levels are low. The challenge is to find the right balance between species to maintain a beneficial relationship.

In the 10 years since the first plantation was established, we have learned a lot about seed zone transfer, seedling propagation, stocking guides, and identification of sites appropriate for red alder. Ultimately, we hope to understand density management effects on red alder growth and yield, and wood quality recovery. In 1998, we got our first real look at differences in growth between the densities. Results are available on the HSC web-page http: **//www.cof.orst.edu/coops/hsc**

The Cooperative's red alder stand management studies are well designed. And they are replicated on a scale rarely attempted in forestry. Over the next 20 years, we will harvest much from our investment. Our data set on growth of managed stands will make red alder one of the better understood forest trees of the Pacific Northwest.

Organizational Activities

Summer Management Meeting- July 1998

July 14th - Meeting:

The Management Committee met on July 14 and 15, 1998 at the Olympic Natural Research Center in Forks, Washington. For both days, the mornings were spent indoors and the afternoons in the field.

The meeting on July 14th began with a presentation by Bob Coon, Managing Director of the Olympic Natural Research Center (ONRC). Bob talked to the group about the Center. ONRC opened in July 1995 in response to the recommendation for forest and marine research by the Commission on Old Growth. The ONRC mission is to fund and promote research that finds the balance between ecology and forest industry needs. ONRC provides a logistic and support base for scientists doing research on the Olympic Peninsula. The center provides lab space, living quarters, GIS and computer accessibility for researchers. Community outreach is also a big part of ONRC purpose. Continuing education programs in science are offered for K-12 teachers and industry folks. ONRC assists Olympic Peninsula teachers to teach science for essential learning requirement 2000. University of Washington provides accredited continuing education courses at ONRC in wildlife biology, ecology, geology and GIS via interactive video and web sites.

Alison Luckett Bower presented the map and matrix of all 37 HSC installations, and a list of field work completed in winter 1998. Alison also handed out a 3 year calendar which shows the work which will need to be done on all HSC installations through 2001. Washington DNR has acquired ownership of one type 3 installation in a swap with Goodyear Nelson Hardwoods, but Goodyear Nelson will continue to manage the site.

A summery of data protocol changes adopted in 1998 was reviewed. We have adopted numerous changes in the past 3 years and most cooperators are still working from the 1990 field manual. An HSC web-page has been developed and an updated manual is placed there. Now members have access to the most up to date field protocol. The web-page is on line at: **http://www.cof.orst.edu/coops/hsc**

Many of the height trees selected in year 3 are no longer dominant in year 6. This shifting of dominance brought up several questions about which trees should be selected for pruning, and if the act of pruning reduces a trees vigor and dominance? Dave Hibbs suggested that dominance likely will be much more stable in older stands. However, this hypothesis has not been tested. We will be looking at the stability of dominance between age 6 and 9 to help get a handle on this question. Bill Volker ask the group if pruning for clear wood is worthwhile? Clear wood fetches a much higher price at the mill and therefore is worthwhile as long as you prune the right trees. If you prune dominant alder trees and they subsequently fall behind, then it is not worthwhile.

Next, Dave Briggs of University of Washington gave a presentation on the Stand Management Cooperative (SMC). The SMC was formed in 1985. It is currently 24 member strong and addresses a wide variety research interests such as forest nutrition, silviculture, wood quality and modeling. The purpose of the SMC is to provide information and develop techniques that can be used in planning and evaluating stand management strategies. The silviculture project of the SMC strives to balance wood quality and growth yield in Douglas-fir and western hemlock plantations. This project currently has 20 Douglas-fir installations, five western hemlock installations and three with 50-50 mixtures of these two species. Each installation has at least one plot at each of six different stocking levels ranging from 100 to 1210 trees per acre. Our HSC red alder study is modeled after the SMC design. Results for initial analysis of SMC data supports the 'crossover ' effect observed by Scott et. al. (1992) in juvenile Douglas-fir plantations. Considering average total height and average DBH, there appears to be little relationship with density for 3 to 9 year old Douglas-fir or western hemlock plantations. A relationship was observed between size and density when only the 100 largest DBH trees per acre were considered. For the 100 largest trees per acre, average DBH and height increased monotonically from widest to narrowest spacing. The next step will be to see if this size increase can be maintained or even enhanced through appropriately timed thinning.

July 14th- Field Tour:

The first stop on Tuesday's field trip was an SMC installation located near Forks, Washington. Bob Gonyea of SMC lead the tour. The site was planted in 1992 with plots of Douglas-fir, western hemlock and 50-50 mixture. The hemlock had very poor survival at this site. Several plots had large holes, but the Douglas-fir is doing quite well. The differences in size between densities was visually apparent, with the largest trees in the dense spacing.

Next we stopped at a HSC Type 2 installation in its third growing season. The trees are doing better than expected in the 5 foot tall salmonberry. They are about two feet above the brush. The wind was blowing quite hard and we all wondered if this site will suffer the same damage as other highly exposed sites when the trees get a little taller.

The final stop for the day was at an HSC Type 2 installation in its 8th growing season. This site sits on a west facing, highly exposed hill slope. The trees experience constant wind that has appeared to damage their crowns and reduce leaf area. The trees on this site are much smaller than trees on other mid-quality sites. This discrepancy between predicted and observed site quality brought up the discussion that perhaps our site quality categories are not properly accounting for all environmental variables. We all agreed this site should be in the low site quality group; however, it is unclear how to determine the site index if Harrington's soil-site system does not work.

This site is up for it's 15-20 ft. HLC thin in the 1200 tpa plot this year. The concern is that reducing the trees per acre from 1200 to 230 will cause the leave trees to all blow down. One suggestion was to thin it in two stages to give the trees time to become wind firm. But many felt this would be introducing a new treatment into the study, and thus would ultimately end up being thrown out of the model. Of course, if it falls down, it will end up being thrown out of the model anyway. This discussion went on for quite some time. It was finally decided that it is best to stick to the original study plan and thin it in one shot.

July 15th- Meeting:

The meeting open with a presentation by Dave Hibbs on budget. The good news is we have a budget surplus thanks to new membership by the Washington Hardwood Commission and the money saving changes made to the data collection process. There will be no dues increase or data collection surcharge for this fiscal year.

Dave Hibbs presented results of preliminary data analysis in 6 year old alder plantations on medium sites. We now have enough data to explore some of the differences in trees size and quality between the 4 planting densities. There is a significant relationship between density, site index and trees quadratic mean diameter for all trees r^2=.81. For the 100 largest diameter trees per acre density was not significant. The mean diameter of these larger trees does not appear to be affected by the density of its neighbors.

This suggests that red alder does a better job of canopy stratification than expected. Site index does account for some of the variation in DBH among the 100 largest trees r^2=.19. A significant relationship was found between site index, density and mean height for all trees r^2=.45. Site index and density were also significant to mean height of the 100 largest trees per acre r^2=.56. The complete report is in the 1998 annual report, and on the HSC web page.

These results initiated a lengthy dialog on how to measure site index in alder. In this analysis, site index was calculated according to the method developed by C.A. Harrington and R.O. Curtis (1988). This method may not be as precise as using tree heights from the installations, but it is effective for removing some of the statistical noise from the analysis and keeps the focus on the size-density relationship. We will analyze the 9 year data using site index derived from relative height on a site when enough data is available.

Doug Belz of Washington DNR presented results from a weed control trial in which cubic volume of growth for first year red alder went from 1000 in the no treatment plot to 1500 in the plot where all competing vegetation was eliminated. Doug used 8/10 ounce per acre of Escort® and Surflan® in the total weed control plot. In the plots where he used 8/10 of Escort®, 95% of the salmonberry cover was killed and the alder gained in growth over the no treatment plot. For levels of application lower than 8/10 ounce per acre of Escort®, there was diminishing difference in growth. Salmonberry did return to a competitive force in 2 to 3 years after application at which time no visible difference in tree size could be seen between the no treatment plot and the plots with herbicide application.

Jerry Hoyer, emeritus silviculturist of Washington DNR, gave a presentation on Douglas-fir tree volume, diameter, limb size and bole damage incidence related to seed source and plantation spacing. Two Nelder design studies were used to compare 11 western Washington stock sources at a range of plantation spacings from 3x3 ft to 20x20 ft. Results are reported after 14 years of observation. Forty percent of the difference in volume per acre was attributed to differences in stock source. With regards the appropriate spacing, Jerry found that targeted mean tree size is attained over a range of about 300 tpa depending on the genetic source, and all other factors held constant. This implies that different guidelines might be appropriate for different areas of the west side for genetic stock reasons. Real genetic gains can be assessed only if volume samples are adequately made and spacing differences accounted for on improved, as well as alternative stock on a range of typical sites. Differences in form were discussed, but were best demonstrated by the field tour.

July 15th- Field Tour:

Our first stop on Wednesday's field tour was one of the Nelder plots used in Jerry's study. Bear damage (feeding at the base of the tree) was relatively high in the study areas. Damage incidence was related to spacing of trees and to source of stock. Stock source differed in incidence of crook, lumps, ramicorn branching and development of large branches in response to spacing. Incidence of wobble and forking was not related to stock source.

The final stop on Wednesday was the Callam Bay Hemlock Plots. Jerry Hoyer and Norm Andersen of Washington DNR installed this study 30 years ago. It is a marvelous example of silvicultural effects on the growth and development of a hemlock forest over the long term. The group wandered through the various spacing and thinning regimes comparing tree size and understory vegetation. We ended the 1998 summer meeting by looking at a naturally regenerated 80 year old mixed stand of Douglas-fir and western hemlock, feeling confident that someday our own regenerated stands can look like this "Old-Growth esque" stand.

A special thanks to Norm Anderson and Doug Belz of the Washington DNR for facilitation such a great meeting.

Winter Management Committee Meeting- January 1999

January 26th- Meeting:

The Management Committee Met on January 26 and 27, 1999 in Corvallis, Oregon. The first day we spent the morning indoors and the afternoon in the field. Day 2 we spent in the field. Day 1 began with Alison summarizing the Field Activity Schedule for winter 1999. All field activities have been completed or are scheduled for completion by June. BIG THANKS to SNF-Hebo District for thinning the orphaned NWH site at Siletz.

In July, 2000 we will loose Gifford Pinchot NF (GPNF) as a member. This may mean 2 more orphan sites to measure. This makes a total of 6 sites for which there is no management, of these, 5 will require work in winter 2000. When a coop member drops out their assistance in maintenance activities usually stops also. Often this cessation of maintenance support is more difficult to compensate for than the loss of a member's annual dues. The group discussed several new membership strategies. It was suggested that greater public awareness would facilitate the recruitment of new members. Tours of our installations and a slide presentation for current member organizations and potential members is needed. Perhaps it is time for another hardwood symposium? These ideas will be pursued after the field season is over in June. Although the continual fluctuation in membership is cause for concern and frustration, we need to acknowledge how far we have come and remember that the work load will gradually get lighter as installations mature.

By the year 2001, we will have enough 9 year data to analyze growth by density and site quality. This brought up the topic of site index. In the 6 year preliminary data analysis presented at a previous meeting, we used the site index originally determined by cutting down trees from the residual stand, or the method derived by Harrington, C.A. and R.O. Curtis (1988). The problem identified in this early analysis is that apparent site index of the new plantation varies with density. This observation raised the issue of how to calculate site index in our next analysis and two observations were made about this issue. First, management clearly has an effect on apparent site index. The problem is that the effect of management on site index is indeterminable in the early stages of growth. Second, the previous stand (the source of our independent estimate of site index) may not be representative of the growth potential of a managed stand. For example, a plantation might be site quality 1 through 3 prior to installation but be expressing a uniform site quality of 1 after installation. Bill Volker suggests calculating site index for each plot by using the largest 20 trees per acre. Between now and 2001, we will continue to explore various approaches to site index to better represent this variable in data analysis.

Next, Randy Johson of PNW Research station gave an update on his study of "Geographic patterns of genetic variation in red alder and their implications for seed transfer and gene conservation." The objectives of this study are:

- to determine how large a seed zone is for red alder on upland sites in Oregon, Washington, and southern BC west of the Cascade crest
- to make comparisons between upland and riparian sites and between slope aspects

- to quantify the extent of with-in vs. between population genetic variation, and
- to develop seed transfer guidelines.

In 1996, seed was collected from 196 trees. 1997 was a poor seed year, and only a few trees were found. In 1998 seed was collected from 200 trees. 1998 was a late seed year and cones were still green in mid November. This spring, plugs will be grown at Weyerheauser Nursery in Aurora, OR. Randy has secured two planting site so far; one on Weyerheauser land in Washington, and one in Monmouth, OR. He is looking for third site, possibly in Oregon's central Coast Range or B.C. A site is 1.7 acres. Some form of weed control and animal protection will be required, but the details are not worked out at this point in time.

Rick Milan- OSU Department of Forest Science gave a presentation on the Tree Genetic Engineering Research Cooperative (TGERC). This co-operative conducts research and technology transfer to facilitate use of genetically engineered cottonwood trees. Genetic engineering is a way to introduce traits not present in the parents, such as: increase glyphosate tolerance, improved insect and disease resistance, and control of flowering. TGERC uses cottonwood trees because the species is amenable to gene-transfer. It is a fast growing, commercial crop; and clonal propagation is rapid after gene insertion. The negative aspects of cottonwood is it has a long juvenile period (6 yrs). It is a poor competitor and requires extensive weed control for successful establishment, and it is susceptible to insects and disease damage. The gene transfer is accomplished using *Agrobacterium tumefaciens* which is the causative agent of crown gall disease and a natural vehicle for gene transfer.

In the area of herbicide resistance, 80 lines of transgenic cottonwoods have been generated and their tolerance to Roundup studied at 3 field sites. A number of lines have demonstrated high levels of tolerance and no detectable growth loss after multiple applications.

In the area of insect resistance, 36 lines of transgenic cottonwoods have been regenerated that contain a synthetic gene based on one from the *cry3a* strain of *Bacillus thuringiensis*. Most of the lines show strong resistance to the cottonwood leaf beetle.

Production of sterile trees is required by the USDA and EPA to prevent the spread of transgenes into the natural population of cottonwood trees. To this end TGERC is currently field testing several hundred lines of trees containing genes expected to conifer pollen and inviable seed. Another method isolates floral homeotic genes which is used to engineer male- and female-sterile trees. Early flowering is needed to see if the sterility procedure is successful, 6 years is too long to wait for the results. So floral regulatory genes are being used to induce flowering in 8 month old seedlings. Finally, the extent of gene flow from hybrid plantations to the wild is being studied and used to predict the impacts of deploying fertile and sterile transgenic trees with new traits.

Paul McCausland Northwest Hardwoods & Washington Hardwood Commission, and Jason Henderson of Marshall & Assoc. gave a presentation on the recently completed inventory of hardwoods in Washington. Interest in native PNW hardwoods increased as a result of Option 9 and job restructuring for displaced timber workers. The WHC received a grant to determine the total hardwood resources base and location for Washington State using landsat images, GIS remote sensing, and FIA data. Refer to page 23 "Other Applied Research" section for more detail.

January 26th- Field Tour:

We met at with Steve Dickerson, John Holte and Steve Carter at the Northwest Hardwoods mill just north of Eugene. We learned the proprietary log grades NWH uses. Alder logs processed at this mill have 1 inch thick boards sawn in a square pattern around a 4 inch thick core. The cores are used for pallet stock. Dave Hibbs brought up that if we pruned alder at a diameter of less than 4 inches, it could increase log value substantially. NWH currently pays about $525 per MBF for top grade and the next grade (M- Medium) fetches about $375/MBF. Below that was $24/Ton for (L-Low). One inch boards of a "Superior" grade lumber could be sawed out of high grade logs even with minor flaws. Epicormic branches were a non-issue. Wholesale values of boards ranged from $1350/MBF for Superior boards down to $235/MBF for pallet stock.

Rings per inch did not affect value. Small dead branch stubs (of 1″ or less) had little impact on value. Sweep was not very important because they could saw 10 ft logs minimizing sweep. What made the most difference was clear wood that can only be obtained when there are no large branches. Sharp angles created defect.

Mechanical processing of logs with a spike roller which is common on cut to length equipment damages alder logs by bruising the wood. This lowers the value of at least 1/2″ thick wood beyond the wound. One other significant defect was «age stain», a brown discoloration caused by felling alder and allowing it to sit in the log yard when air temperatures exceed 65 degrees F. Age stain can reduce the value of the logs and lumber by half. Other species processed at this mill were bigleaf maple and Oregon ash.

January 27th- Field Tour

We met at Siuslaw National Forest Hebo Ranger District office. Alison and Dave gave a brief summary of the HSC background and the installation designs. John Johansen of the Hebo Ranger District gave introduction and history of sites.

Our first stop was Type 1 Installation, natural stand. «Battle Saddle» Installation This site is steep, about 70% slope, with west facing aspect. Natural alder stand was harvested in 1973, broadcast burned and planted with Douglas fir in 1975. Regeneration totally failed and site naturally regenerated to red alder. It became a study installation and was thinned in 1990. This is the only Type 1 installation with a pruned plot. We walked through the 525 TPA plot first. There are only small gaps in the canopy as evidence by the minimal amounts of salmonberry on the plot. Average tree size is 17 cm dbh, 15 m height, and 10 m height to live crown.

The second plot has 230 TPA and was pruned in 1992. Average tree size is 20 cm dbh, 15.5 m heigh, and 9 m height to live crown. Sitka spruce and western hemlock saplings were present. Trees were pruned with pole saws up to about 6 m. Most branch stubs have healed over. Epicormic branches were not common. Most of the trees in both densities would be "High grade logs" according to Northwest Hardwood's standards.

Our next stop was Type 2 installation "Pollard Alder". This was a natural alder stand prior to harvest. Site was planted in 1991, but the stock was poor and so had to be replanted in 1992. In 1994 there was a bad fungal outbreak. First thinning occurred in 1996.

Dave Hibbs pointed out that alder was sensitive to moisture competition. Convex slopes had markedly shorter trees because of less available soil moisture. Trees in the 230 TPA treatments were shorter than the higher densities. According to Dave, this was because at higher densities that alder was able to occupy the site better. In more open stands, understory shrubs, forbs and grasses competed strongly against alder; the result was much shorter tree heights. This difference in height was striking. In the 1200 TPA and 525 TPA plots, tree height was often 1 1/2 to 2 times the height of trees in the 230 TPA treatments.

The discussion centered around timing for the second pruning lift to 4 m height to live crown. Dave said there were 3 concepts of pruning practiced in Europe:

1. Lifting of branches to obtain a clear bole.
2. Pruning branches greater than certain diameter, no matter where they appeared on the stem.
3. Pruning for form, removing forks and ramicorn branches.

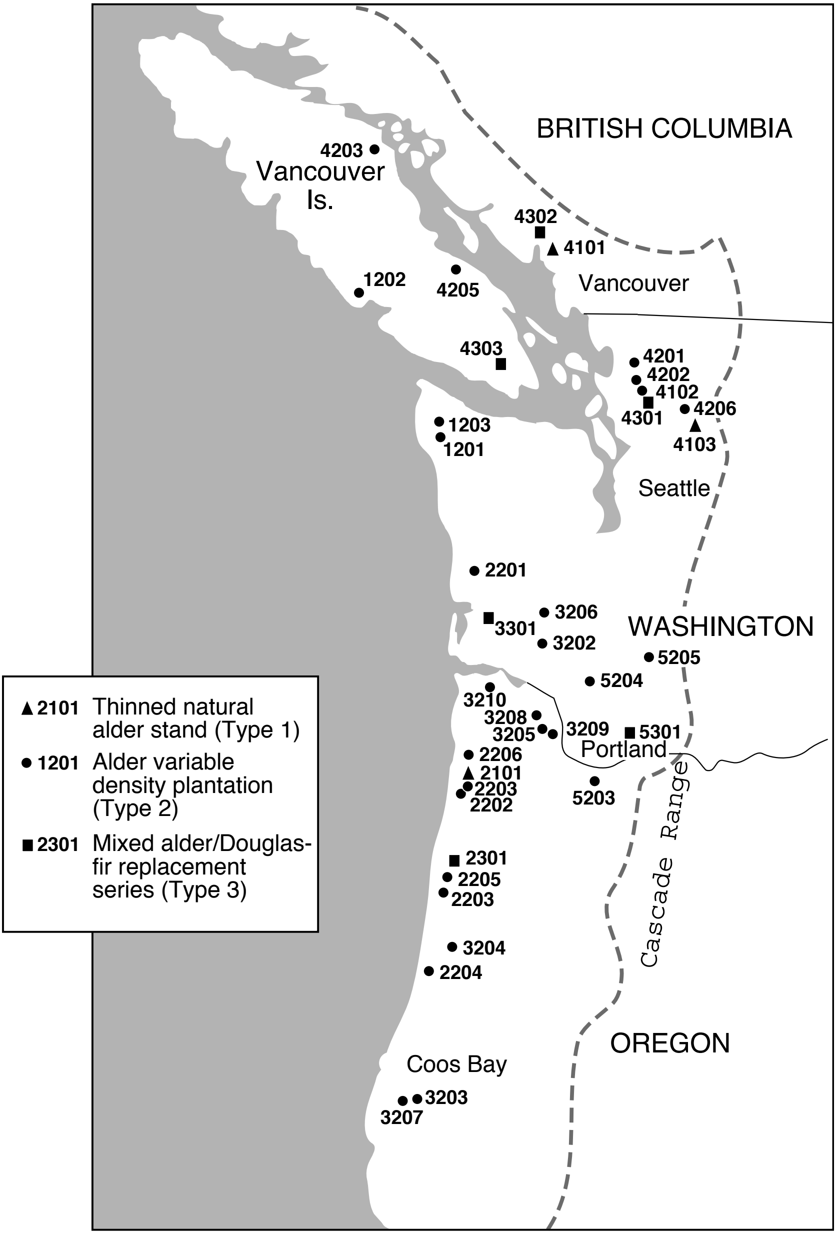


Figure 1. Location of existing installations for the Red Alder Stand Management Study.

Our final stop was at the Cedar-Hebo Type 3- Douglas-fir red alder mix Installation. This site was planted in 1996. We walked into the 25% alder and 75% Douglas-fir plot. Alder are 3-4 m tall and the Douglas-fir are 1 m. Many of the firs have died or have very poor vigor. It was decided to interplant Douglas-fir in the plots and other conifers into buffer. The other conifer species is of interest in light of the Swiss Needle Cast epidemic in this area. We will keep Douglas-fir in the measurement plots so that this site is compatible with all the other type 3 installations.

Cooperative Research

Red Alder Stand Management Study

The Red Alder Stand Management Study has 36 installations. These study installations are located throughout the Coastal Mountain Range of the Pacific Northwest from Vancouver Island, BC Canada to Coos Bay, Oregon (Figure 1). These installations can be divided into three specific types:

- Type 1 is a thinned natural alder stand (230 and 525 tpa). There are four Type 1 installations.
- Type 2 is a variable density alder plantation (100, 230, 525. 1200 tpa). There are twenty-six Type 2 installations.
- Type 3 is a mixed alder/ Douglas-fir plantation (350 tpa with variable proportion). There are seven Type 3 installations

Type 2 variable density plantations are the primary focus of this study. Type 2 installations are distributed across a matrix of five ecological regions and three site qualities (Table 1). In Table 1, each site is identified by installation number, ownership, and year it was planted.

In 1999 all 26 Type 2 installations moved beyond the establishment phase. Specifically, the 3rd year growth measurements has been completed on 22 installations, and the first thinning treatment has been completed on

Table 1. Matrix of Type 2 installations. Each successful installation identified by number, ownership, and year planted.

Region	Site Quality Low SI_{50} :23-27 M SI_{20} :14-17 M	Site Quality Medium SI_{50} :28-32 M SI_{20} :18-20 M	Site Quality High SI_{50} :33+ M SI_{20} :21+ M
1) Sitka Spruce North	X	1201 DNR '91	1202 BCMin '94 1203 DNR '96
2) Sitka Spruce South	2202 SNF '91 2206 SNF '95	2203 NWH '92 2204 SNF '94	2201 WHC '90 2205 NWH '94
3) Coast Range	3204 SNF '92 3209 BLM '95	3202 WHC '90 3205 ODF '92 3207 BLM '94 3208 ODF '97	3203 NWH '92 3206 WHC '93 3210 OSU '97
4) North Cascades	4205 BCMin '94	4202 GYN '90 4203 BCMin '93 4206 DNR '95	4201 GYN '89
5) South Cascades	5205 GPNF '97	5203 BLM '92 5204 WHC '93	X

Definition of Acronyms

BCMin-British Columbia Ministry of Forests.
BLM-Bureau of Land Management.
DNR-Washington Department of Natural Resources.
GYN-Goodyear-Nelson.
GPNF-Gifford Pinchot National Forest.
MBSNF-Mt. Baker Snoqualmie National Forest.
NWH-Northwest Hardwoods.
ODF-Oregon Department of Forestry.
OSU-Oregon State University Forest Research Laboratory.
SNF-Siuslaw National Forest.
WHC-Washington Hardwood Commission.

14 installations. Five installations have had a second thinning treatment, and 4 installations have had 9th year growth measurements. It is expected that enough 9th year data will be collected by 2001 to begin comparing differences in growth between thinning treatments.

A installation is thinned for the second time when the average height to live crown reaches 4-6 meters. We are finding that the timing for this thinning varies greatly among installations, and appears to be a function of site quality. The best sites are ready to thin as early as year 8, but on installations with poor site quality crown closure and crown lift is postponed. These installation may not be ready to thin until year 10-12. Current protocol is to measure an installation every 3 years until year 9, and then shift to measuring every 5 years. But if the second thinning treatment is not happening before year 9 then we may miss measuring the change in growth as a response to thinning. Therefore, we need to maintain the 3 year measurement cycle through year 12.

At the summer 1998 meeting, Alison presented data on the observed shift in dominance among larger trees between years 3 and 6. During these early years of growth and crown closure, the 100 biggest trees per acre (tpa) did not remain constant. The group hypothesized that this shift is a short lived phenomenon and between years 6 and 9 dominance would stabilize. In the fall of 1998, year 9 measurements were completed on the first 2 installations, and the 100 biggest tpa was the same trees as in year 6 on all densities. So dominance did stabilize in these two installations. We will continue to watch this trend as more data becomes available

This issue of early shift in dominance made us re-evaluate methods for selecting trees for pruning. Do you select the biggest trees or select by systematic grid system? The grid system is more logical if the biggest trees change over time, or if the site is to be thinned.

Numerous changes to data collection protocol were adopted in 1998. The change that saved the most time and money is the method for selecting the height trees on a measurement plot. For both the old and new methods of selecting trees for height measurement the objective is the same; and that is to measure heights on the 10 trees in the smallest diameter classes, 10 trees in the largest diameter classes, and 20 in the middle of the diameter distribution. The new method is to construct the diameter distribution for the plot as the trees diameters are being measured. Therefore, a tree is selected for height measurement on the first pass through the plot. The old protocol required the crew to pass through the plot measuring diameters, then sorting diameters into classes, select trees, and then pass through the plot a second time to find and measure the selected trees. The problem with this method is that a lot of time is wasted looking for the selected trees because trees are rarely numbered sequentially. Adopting the new one pass method has cut time spent in a plot by 50%. But is it as effective at capturing the range of diameters required? A graph of a plot measured the new one pass way shows that the 40 height trees are properly dispersed though the diameter distribution, and only two diameter classes were missed (Figure 2). Figure 2 appears to show missed trees in the smallest diameter class,

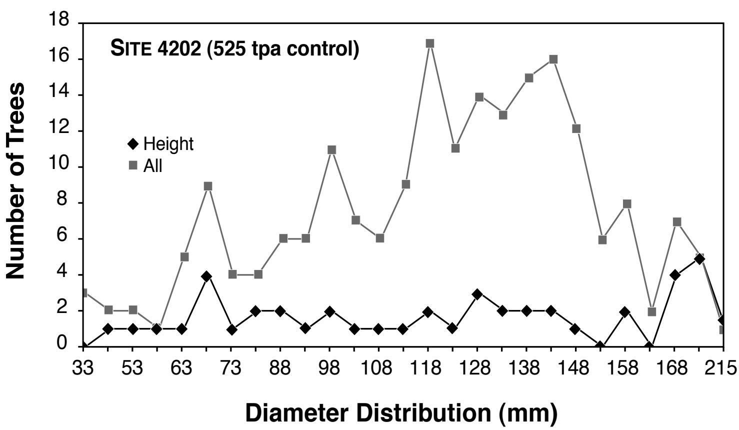


Figure 2. Comparison of actual number of trees in diameter classes and number of trees measured for height in diameter classes. The goal is to measure heights on 10 trees in the smallest diameter classes, the 10 trees in the largest diameter classes, and 20 spread across the middle of the diameter distribution.

this is due to trees being either dead, broken, or missing a tag, which are common problems on small suppressed trees.

Other Applied Research

Washington Hardwood Commission's Geographic Information System Project

The Washington Hardwood Commission's Geographic Information System Project is a joint effort between the Washington Hardwood Commission, Washington Department of Natural Resources, and USDA Forest Service. It was designed as a comprehensive inventory of the hardwood resources in western Washington with the results to be formatted in a way to better predict timber supply and fluctuations in supply.

This project began by identifying alder acreage using GIS technology. Specifically, 1994 Landsat Thematic Mapper Data has been classified for hardwoods using DNR's Forest Resource Inventory Survey Plots as training sites. Then, field truthing verified a 90% accuracy for this classification and inventory system. To date, it is the most comprehensive, broad scale assessment of hardwood resources for western Washington.

This project has generated new Scribner volume estimates for red alder by site class, and age categories. These new estimates are based on Forest Inventory Analysis (FIA) data and alder acerages developed in the satellite inventory.

Because the results of this effort are based in a GIS system, they can be used to address many questions about factors that affect the supply of hardwoods in western Washington. For example, analyses of the hardwood volumes derived from this project have considered the effects of the existing urban areas and urban growth areas proposed under Washington State's Growth Management Act, as well as the regulations in the Habitat Conservation Plan adopted by the Washington DNR.

Additional analyses of the other factors affecting the supply of hardwoods considered in the volume estimates are: issues of ownership and management practices, estimated of current harvest rates, and estimates on short- and long-term sustainable harvest rates. Predictions on short- and long-term availability show various scenarios of impact of regulations, urban growth, and management practices, as well as a historical look at how unexpected events such as ice storms have effected the current supply of hardwoods.

DIRECTIONS FOR 1999-2000

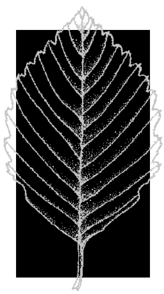
The goals for the new year fall into three categories:

- Increase membership
- Data Analysis- elaboration on the preliminary data analysis
- Data Management- data set cleaning, compatibility, and archiving

Increase membership- At the July 1998 Management Committee meeting much discussion centered on ways to attract new members and increase public awareness of the HSC. Our first achievement towards this goal was creating the HSC web page http: **//www.cof.orst.edu/coops/hsc**
In July 1999, a new brochure will be available which tells the story of the Hardwood Silviculture Cooperative in clear, non-scientific terms. We plan to distribute it in conjunction with a slide show that can be presented to interested groups and organizations.

Data Analysis- The preliminary data analysis of 6 year data was completed in 1998. It compared tree growth between the 4 planting densities on eleven Type 2 installations. The results raised many questions and pointed to site quality as an area for further investigation; but more data is needed for a through investigation. We project that by 2001 we will have the data required to compare growth with site quality, as well as, thinning treatments. Twelve years of dedication and hard work has been invested in this project by HSC members; it is exciting to began to see the rewards.

Data Management- There have been many changes in data collection protocol over the past ten years and one of our biggest challenges is to achieve variable compatibility. This is the a critical step in developing our growth model. We have made some progress, but it is a task that will take much time and attention. We will continue to chip away at it in between field seasons.



Appendix 1.
Financial Support Received in 1998-1999

Cooperator	Support
BC Ministry of Forests	$8,500
Bureau of Land Management	$8,500
Gifford Pinchot National Forest	$8,500
Goodyear-Nelson Hardwood Lumber Company	$4,500
Oregon Department of Forestry	$8,500
Siuslaw National Forest	$8,500
USDA Forest Service PNW Station	In kind
Washington Department of Natural Resources	$8,500
Washington Hardwood Commission	$8,500
Subtotal	$64,000
Forestry Research Laboratory	$49,943
Total	$113,643