



CRAFTS

Annual Report
1992-93

FOREST RESEARCH LABORATORY
OREGON STATE UNIVERSITY

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Herbaceous Vegetation Management Research

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CRAFTS

Coordinated Research On
Alternative Forestry
Treatments & Systems

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Forest Research Laboratory
Oregon State University

HIGHLIGHTS 1992-93

This report presents the CRAFTS Cooperative's activities in forest vegetation management research. The thirteenth year's highlights include:

- Nearly 100 growth monitoring plots were established in the Coast Range of Oregon and Washington in support of the development of the Regional Vegetation Management Model (RVMM).
- The herbaceous vegetation study was redesigned to assess the relationship between amount of area free of herbaceous vegetation and Douglas-fir growth and survival. This study was installed on three sites in west-central Oregon.
- A joint study with the Willamette National Forest and the Pacific Northwest Forest Research Station was begun to determine the effects of forage seeding on conifer survival and growth as well as associated vegetation development.
- The 10-year data set for the Coast Range Competition Release Study was completed.
- Tim Harrington, the Associate Director of CRAFTS, left to accept a tenure-track Assistant Professor position at the University of Georgia.
- Alex Pancheco was hired as a Faculty Research Assistant to assist data collection for the various research projects.

CRAFTS COOPERATORS

Members

Boise Cascade Corporation
British Columbia Ministry of Forests
Bureau of Land Management
Cavenham Forest Industries
Champion International Corporation
International Paper Company
ITT-Rayonier, Inc.
Lone Rock Timber Company
Oregon Department of Forestry
Oregon State University
Simpson Timber Company
Starker Forests, Inc.
Washington Department of Natural Resources
Weyerhaeuser Company
Willamette Industries, Inc.

Liaison Members

University of British Columbia
University of Washington
USDA Forest Service, Pacific Northwest
Research Station

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INTRODUCTION

This has been a year of transition for the CRAFTS Cooperative. As Will Schneider and I were getting accustomed to our new positions, Tim Harrington accepted a tenure-track Assistant Professor position at the University of Georgia School of Forestry. We wish him well in his new situation. This vacancy resulted in several changes for the CRAFTS staff. Steve Radosevich reassumed a more active role in the Coop leadership and Will and I moved into more responsible capacities overseeing research projects rather than merely coordinating field activities. To help in data collection after Tim's departure, we have added Alex Pancheco to the CRAFTS staff as a new Faculty Research Assistant.

Our changes have not only been in personnel but in our research activities as well. We have nearly completed data collection for the Regional Vegetation Management Model in the Coast Range and are preparing to move into the Cascades. The herbaceous vegetation study has been revamped and re-initiated. The 10-year data collection for the Coast Range Competition Release Study has been completed and its future is being determined. We have a new study on forage seeding with the Willamette National Forest. Our program is moving in new and exciting directions.

Progression in the Cooperative's research agenda is a reflection of transforming attitudes about forestry in the region. Views of how to think about forests and their management are changing. While a diversity of species is emphasized by some as the key to a stable ecosystem, a diversity of management alternatives may produce both stable economies and ecosystems to the benefit of both people and the environment. CRAFTS currently is well-positioned to examine the history of what has been done, as well as the implications of what is being done, and guide the future of what might be done in management of early forest stands.

D. Eric Hanson

CHANGES IN PERSONNEL

There were two personnel and one appointment change for the CRAFTS Cooperative this year:

- After ten years with CRAFTS, Tim Harrington accepted a tenure-track Assistant Professor position at the University of Georgia's D.B. Warnell School of Forest Resources. He left in August and now is teaching and initiating own his research program in silviculture and applied ecology.
- In March, Alex Pancheco joined CRAFTS staff as a Faculty Research Assistant in the Forest Science Department. Alex is a recent employee on the Siuslaw National Forest and a 1983 forestry graduate from the University of California at Berkeley. His responsibilities will be to coordinate field data collection in the Cascades for the Regional Vegetation Management Model with Will Schneider and to assist on the BLM seedling mortality study and the herbaceous vegetation study.
- Eric Hanson's appointment was changed from a temporary Faculty Research Assistant to a fixed term Faculty Research Assistant in October.

RESEARCH

The CRAFTS research program addresses three key areas of forest vegetation management:

- **Interactions of Conifers and Associated Vegetation:** Quantifying the survival and growth of young conifers in response to various vegetation components, and the development of those components in forest stands.
- **Vegetation Management Techniques:** Testing tools and methods for managing and their effects on vegetation in young conifer stands.

- **Ecological Studies in Managed Stands:** Examining the patterns and processes in the evolution managed stands.

Interactions of Conifers and Associated Vegetation

An integral part of CRAFTS research centers on assessing the need for, effects of, and responses to vegetation management treatment by forest stands.

Coast Range Competition Release Study

Tenth year data was collected from the remaining three installations last summer. These data support the previous conclusions drawn except that tree volume in the chemical release treatments did not differ from the manual treatments and in the operational treatments was not different from the control. The total vegetation control plots continued had greater tree volume than all other treatments. There was no effect of treatment on tree survival. The cursory results of this study are presented by Schneider and Knowe in a CRAFTS Technical Report (January, 1993).

Herbaceous Vegetation Study

The herbaceous vegetation study was underway on two Weyerhaeuser sites last year with plots installed, treatments applied, and vegetation sampled. As the summer progressed, concern developed about the efficacy of some treatments, especially the 50% and 75% partial vegetation control. After a meeting and field tour of one site, it was decided to abandon the existing study sites and revise the experimental protocol. Portions of the study were determined to be important and were retained. These included the herbaceous and woody control treatments and the total vegetation control treatment. The partial vegetation control, grass seeding, and timing aspects of the study were deleted.

The study's emphasis shifted to investigating the area of herbaceous influence around trees. Circles with radii from 1' to 5' are sprayed around the trees to remove the herbaceous vegetation. The area of vegetation control will be maintained throughout the growing season for two years. Woody vegetation is controlled on the entire plot where area of influence treatments are applied. A relationship between the vegetation-free area around the tree and survival and/or growth will be determined. The plot layout, tree measurement, and vegetation sampling protocols are unchanged (described in the 1991-92 Annual Report).

Three sites have been installed with treatments applied and initial tree measurements taken. Vegetation sampling will be conducted in July. Tree measurements will be taken in the fall and analyzed for first year effects. This study will be conducted for three years but is designed to be viable up to pre-commercial thinning.

CLUMP and Sprouts - Effects of Bigleaf Maple on Growth of Douglas-fir

Weyerhaeuser provided a dataset to further examine the impacts of bigleaf maple clumps on growth of young Douglas-fir. Periodic annual height and diameter growth models that accounted for: 1) seedling size at age 7 (the beginning of the growth period), 2) size of the bigleaf maple clump, and 3) distance between the bigleaf maple clump and the planted Douglas-fir were developed. The equations were used to estimate periodic annual growth loss between 7 and 11 years of age (Figure 1). These graphs show that a Douglas-fir tree (20 mm dbh and 200 cm height at age 7) planted 3 meters away from a bigleaf maple sprout clump with a 3-meter crown diameter will incur about 10 percent reduction in periodic annual dbh growth and 12 percent reduction in periodic annual height growth during the four-year interval. Details of the model development and comparisons of growth effects have been submitted as a refereed journal article (Knowe, Carrier, and Dobkowski, 1993).

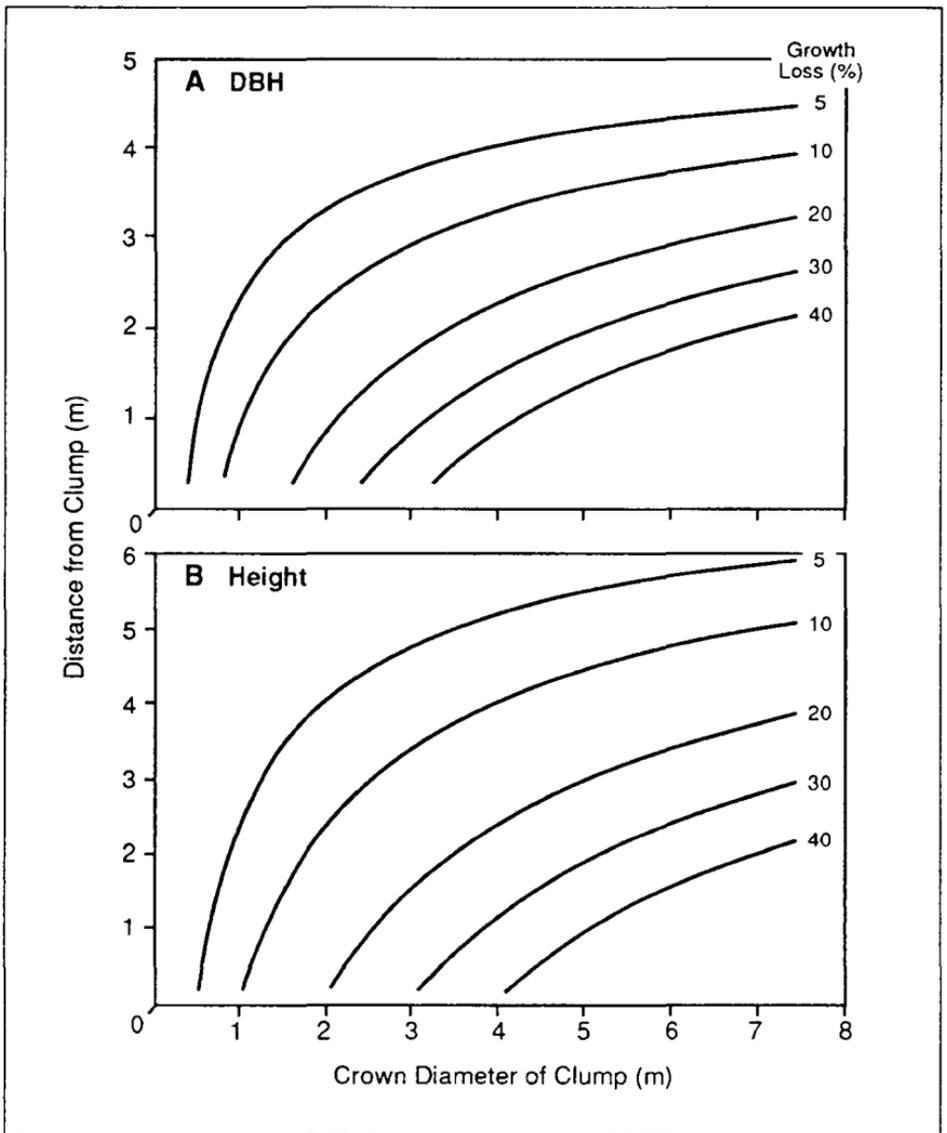


Figure 1. Periodic annual growth loss for Douglas-fir between 7 and 11 years by distance from the bigleaf maple sprout clump and crown diameter of the bigleaf maple sprout clump. A. Periodic annual dbh growth loss for 20 mm dbh at age 7. B. Periodic annual height growth loss for 200 cm height at age 7.

Regional Vegetation Management Model

The major emphasis of the Regional Vegetation Management Model during the past year was the establishment of growth monitoring plots in the Coast Range of Oregon and Washington and, concurrently, the development of a RVMM demonstration model. The plot installations provide a coherent and consistent extension of the modeling database based on a dataset matrix, and sampling and data collection protocols (described in the 1991-92 Annual Report). The purpose of the RVMM demonstration model is to evaluate on-going modeling approaches and to provide a "shell" for later versions of the model.

The establishment of growth monitoring plots was aimed at filling several gaps in the Coast Range modeling database including competition effects (inter- and intraspecific), species representation, and stand age. Guiding plot installation was a dataset matrix which focused on three plant associations (as indicators of site productivity - low, medium, high), four tree height classes (0-5, 6-10, 15-20, >25 feet), three combinations of site preparation and tree release from associated vegetation, and two replications per cell (minimum of 72 cells). In practice, the number of matrix cells exceeds this minimum number due to the inclusion of intermediary tree height cells and additional cells in pre-commercially thinned stands. Each of the dataset cells represents a 0.10- to 0.15-acre Douglas-fir measurement plot (PMP) containing four 0.01 acre competition measurement plots (CMPs). The initial plot measurement will be followed by a second measurement 2 years later. Sampling and data collection protocols which support both tree- and stand-level modeling approaches were developed and used.

Nearly 100 Coast Range PMPs were installed and measured in the last year (Table 1). Data formatting has been completed. Data cleaning and summarization in preparation for yield modeling is currently underway. During the next year, plot installation will begin in the

Table 1. The distribution of the Regional Vegetation Management Model Douglas-fir measurement plots (PMP) for the Coast Range by organization and site productivity class and totals.

Organization	High	Medium	Low	TOTAL
BLM	3	•	1	4
Boise Cascade	1	4	3	8
Champion (Campbell's)	2	•	•	2
IP	8	3	1	12
ITT	•	10	•	10
Lone Rock	4	•	•	4
ODF	•	•	3	3
PNW Res. Sta.	19	•	4	23
Simpson	4	3	4	11
Starker	4	2	1	7
Weyerhaeuser	•	1	5	28
Willamette	•	2	4	6
TOTAL	46	29	23	98

Cascades Region using the Coast Range dataset matrix as a guide.

Models for predicting diameter distributions, projecting stand tables, dominant height growth, cover growth, and individual tree heights have been updated using the 10th year remeasurements of the CRAFTS Coast Range Competition Release Study. These models have also been integrated into a demonstration version of the young stand simulator for Douglas-fir in the Coast Range. Although the simulator is based on limited data, it synthesizes observed tree responses in the experiment, serves as a shell for the detailed stand-level models to be developed from the new data being collected for this propose, and demonstrates some of the inputs and outputs from the RVMM.

The ultimate goal of the RVMM is to provide reliable predictions of young stand growth for a full range of silvicultural regimes founded on a regional database.

BLM Seedling Mortality Study

As a result of reduced harvesting and general lack of suitable sites, the seedling mortality study has been somewhat reduced in scope and size. The study will no longer contain a comparison of burned versus unburned areas. Research plots have been installed, however, on a total of 13 sites ranging from Myrtle Creek in the north to Applegate in the south and east from Butte Falls to west of Wolf Creek. This distribution still provides the wide geographic area needed to encompass variation in sites as the study intended. As the study installation is staggered in time, initial tree measurements have been completed on all sites and first year measurements are finished on those established last year. The data have not been analyzed for those sites. Vegetation assessments, which will be biennial, will be done in July on the newly installed sites. Fall tree measurements will occur on all sites. This study will be conducted for three years.

Willamette NF Forage Seeding Study

The Willamette National Forest, PNW Research Station, Oregon Department of Fish and Wildlife, and OSU Forest Science have begun a joint project to study forage seeding effects on Douglas-fir growth and associated vegetation development in the Oregon Cascades. The objectives of the study are to examine the effects of seed mixture, fertilizer, and application timing on Douglas-fir and associated vegetation. Two forage seed mixes, one grasses and legumes and the other legumes only, will be applied with and without fertilizer both in the year of tree planting and one year later. The study will be conducted on two sites: one in a Douglas-fir vegetation type and the second in a western hemlock zone. Each study will be replicated on-site. The plot design is similar to the herbaceous study with treatment plots containing an interior measurement plot.

One site has been installed with treatments applied and initial tree measurements taken. Data collected will be

the same as in the herbaceous study with vegetation sampling following the RVMM protocol to be conducted in July. Tree measurements will be taken in the fall and analyzed for first year effects. This study will be conducted for three years but is designed to be viable up to pre-commercial thinning.

This study is unique because it is our first research project in a “new forestry” stand. About eight trees per acre have been left on site and will be carried through rotation. Although it does not affect this study, the stand structure will make it difficult to incorporate these data into the RVMM database.

Douglas-Fir and Western Hemlock Responses to Different Vegetation Management Regimes.

Data collection and analysis are continuing on vegetation management effects on conifers project which is funded by Weyerhaeuser Company and DowElanco. Mike Newton and associates establish a study which examine the effects of various vegetation managements regimes on the growth of Douglas-fir and western hemlock.

Liz Cole has completed preliminary analyses on the third-year hemlock measurements. Stem volume growth in year three was greater in the weed-free, directed spray, and 1st + 2nd year release treatments than in the control and conventional treatments (Table 2).

Elk browsing on two of the four Douglas-fir sites confounded the second year analysis. Treatment differences were greater on sites with no elk browsing. For both browsed and unbrowsed seedlings, stem volume growth was negatively related to percent vegetative cover (Figure 2).

Riparian Silviculture Study

Mike Newton, Liz Cole, and Jenny Walsh, in cooperation with Cascade Timber Consulting, Starker Forests, Inc., Weyerhaeuser Company, and Oregon Department of For-

Table 2. Vegetation treatment effects on third year height, diameter (@ 15 cm), and stem volume growth of western hemlock.

Treatment	Height (cm)	Diameter (mm)	Volume Growth (cm ³)
Untreated	209 b ¹	21.6 c	244 b
Conventional	220 ab	23.1 c	287 b
Year 1 Release	221 ab	25.6 bc	383 ab
Year 1 + 2 Release	242 a	29.6 ab	557 a
Year 2 Release	246 a	28.0 ab	480 ab
Directed	237 ab	30.2 a	564 a
Weed-free	232 ab	32.2 a	617 a

¹ Means within columns followed by the same letter are not significantly different (P=0.05) using Bonferroni's adjusted LSD.

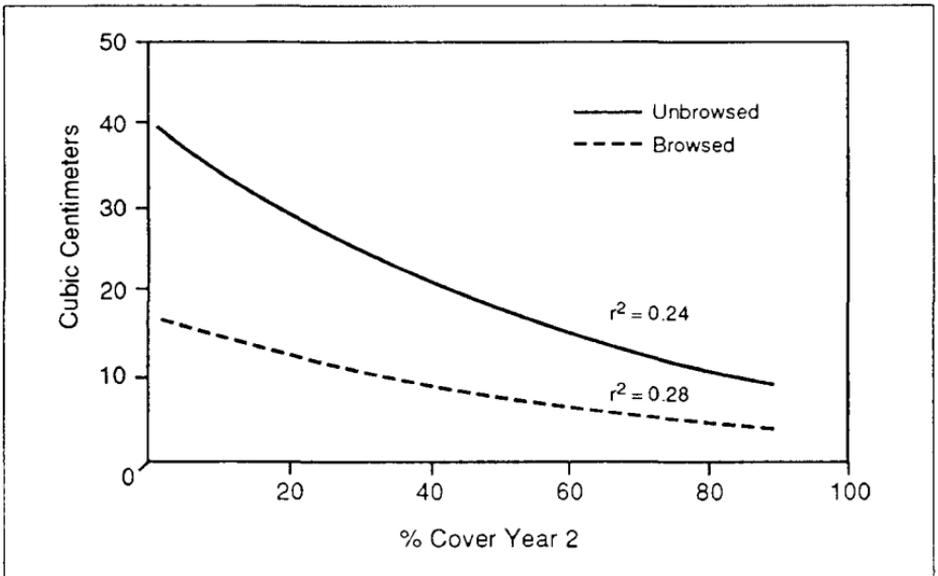


Figure 2. Relationship between stem volume growth (cm³) and percent vegetative cover for 2-year-old browsed and unbrowsed Douglas-fir. The equation for volume growth of browsed seedlings is: $\ln(\text{volume growth}) = -2.428 - 0.0163(\text{vegetative cover in year 2}) + 1.358 \ln(\text{initial height})$, $r^2 = 0.28$. The equation for volume growth of unbrowsed seedlings is: $\ln(\text{volume growth}) = -2.428 - 0.0163(\text{vegetative cover in year 2}) + 1.358 \ln(\text{initial height})$, $r^2 = 0.28$.

estry, have established a research project to evaluate the establishment of conifer plantations in riparian areas. Rather than maintain the conventional riparian buffer strip, special permission was obtained from the Oregon Department of Forestry allowing logging to occur next to stream channels. Two sites each in the Coast Range and the Cascade foothills were recently clearcut, and planted with western hemlock, Douglas-fir and western redcedar. Tree growth and associated vegetation development will be assessed. Streams will be monitored at various locations on each site for summer water temperatures, and benthic macroinvertebrate response.

The two coastal sites are part of a COPE project involving Arne Skaugset and Loren Kellogg. Kellogg conducted time and motion studies to determine if extra logging time were required to protect stream channels. Skaugset and his associates will be monitoring stream temperatures and the effects of logging and loss of cover on stream channels. This study is designed as to be completed in 2 years.

Vegetation Management Techniques

Plant Community Response to Hexazinone Rate and Formulation.

Using data collected from the study comparing hexazinone rate and formulation for control of herbaceous vegetation (described in the 1991-92 CRAFTS Annual Report), Eric Hanson conducted an analysis of the effects of herbicide rate and formulation on absolute and relative cover physiognomic type, as well as species diversity using the Simpson and Shannon-Wiener indices. A linear decrease in Shannon-Wiener species diversity ($P=0.030$) with increased hexazinone rate and an interaction of formulation by rate³ for Simpson diversity ($P=0.038$) were found (Figure 3). Control diversity was not different from treated in either case. Decreasing Shannon-Wiener diversity indicates either

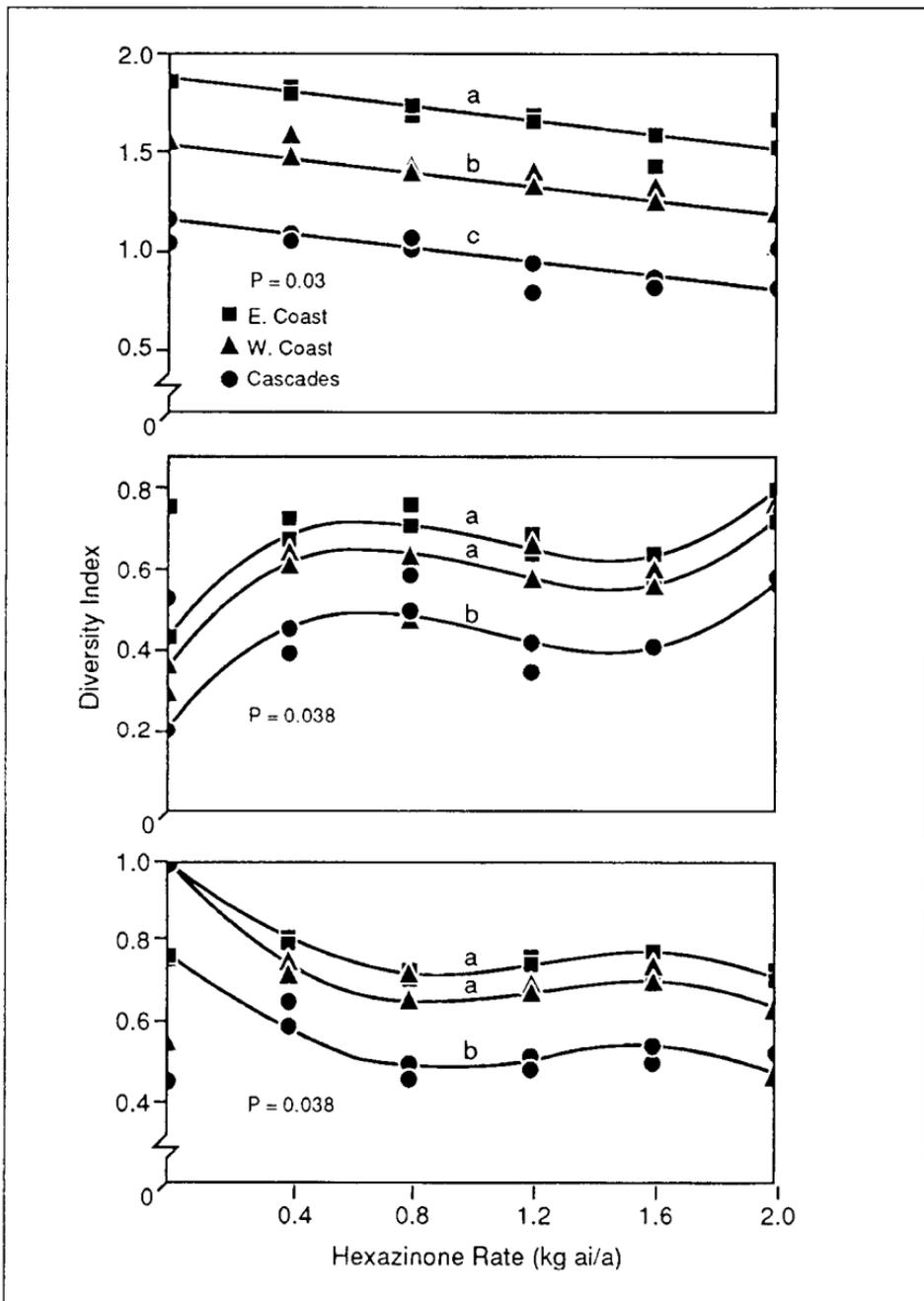


Figure 3. Effect of hexazinone rate on plant species diversity index. Lines with the same letter are not different. P-value is for the overall regression. A. Shannon-Wiener diversity index. B. Simpson diversity index with liquid hexazinone. C. Simpson diversity index with granular hexazinone.

diversity was lost as fewer hexazinone resistant species replaced more susceptible ones or species evenness decreased as susceptible species were eliminated. Changes in Simpson's index could result from an initial loss of susceptible species and then reduced dominance of less susceptible ones. Both absolute and relative herbaceous cover in control plots was different from treated cover ($P=0.000$ and $P=0.041$). There was a linear decrease in both absolute and relative herbaceous cover with increased hexazinone rate ($P=0.000$ and $P=0.013$). There was also a linear increase in relative shrub cover with increased rate. As susceptible species were removed with increased hexazinone, herbaceous cover decreased and relative shrub cover increased.

As this was only first year data, the vegetation will be sampled again this July, 3 years after treatment, to assess the longer term effects of the herbicide on the plant community

Ecological Studies of Managed Stands

These studies provide the basis for alternative management approaches, as well as information about the biological drivers of managed forests.

Growth and Nitrogen Response of Douglas-fir in Association with Red Alder

Laura Fuentes, a M.S. student, has completed collecting data for her research project (described in the CRAFTS 1991-92 annual report) and is in the process of analyzing it. She will be writing a thesis and manuscript which should be completed this summer.

Effects of Nitrogen and Competition Three Forest Herb's Population Dynamics

Eric Hanson is continuing work on his dissertation project studying wood groundsel (*Senecio sylvaticus*),

foxglove (*Digitalis purpurea*), and native fireweed (*Epilobium angustifolium*). Preliminary results indicate that survival of these three species may be directly related to nitrogen availability. Herbivory also seems to be an important factor since, in the first year, fireweed was browsed to the ground by deer while groundsel and foxglove were unaffected.

This year an experiment will be harvested which will assess the effects of nitrogen and competition on seed production and viability. Vegetation assessments will be conducted on the CRAFTS herbaceous vegetation study sites both inside and outside the fence, as well as on the Willamette National Forest forage seeding study sites. This study will be conducted for three years.

TECHNOLOGY TRANSFER

CRAFTS disseminates its research information to Cooperators in a variety of ways including reports, presentations, and personal communication.

Two technical reports (see below) were released this year to inform Cooperators about project results, as well as two quarterly research updates to keep them abreast of the status of current projects. The complete listing of reports contained in each update is provided in "Progress Reports and Newsletters." In addition to the written reports, the CRAFTS staff made seven presentations to Cooperators, which are listed below. A complete listing of staff members' publications and presentations is furnished under "Publications and Presentations".

Technical Reports

Knowe, S.A., B.D. Carrier, and A. Dobkowski. 1993. Impacts of bigleaf maple sprout clumps on growth of young Douglas-fir. CRAFTS Technical Report, Forest Research Laboratory, Oregon State University, Corvallis. 13 p.

Schneider, W.G., and S.A. Knowe. 1993. Growth and survival of Douglas-fir in the Coast Range ten years after competition release treatments. CRAFTS Technical Report, Forest Research Laboratory, Oregon State University, Corvallis. 12 p.

Presentations to Cooperators

- Difficulties with and proposed changes to the herbaceous vegetation study. D.E. Hanson and S.A. Knowe. CRAFTS Scientific Retreat: A Joint Meeting of the CRAFTS Policy and Technical Committees. November 1992.
- Predicting the impacts of bigleaf maple clumps on growth and yield of Douglas-fir. S.A. Knowe. CRAFTS Scientific Retreat: A Joint Meeting of the CRAFTS Policy and Technical Committees. November 1992.
- State of the vegetation management discipline. S.R. Radosevich. CRAFTS Scientific Retreat: A Joint Meeting of the CRAFTS Policy and Technical Committees. November 1992.
- Update on the BLM Seedling Mortality Study. W.G. Schneider. CRAFTS Scientific Retreat: A Joint Meeting of the CRAFTS Policy and Technical Committees. November 1992.
- Update on the Coast Range Competition Release Study. W.G. Schneider. CRAFTS Scientific Retreat: A Joint Meeting of the CRAFTS Policy and Technical Committees. November 1992.
- Update: Development of the Coast Range RVMM Database. R.G. Shula. CRAFTS Scientific Retreat: A Joint Meeting of the CRAFTS Policy and Technical Committees. November 1992.
- Update: Forage seeding study proposal and status of the hexazinone pilot study. D.E. Hanson. CRAFTS Scientific Retreat: A Joint Meeting of the CRAFTS Policy and Technical Committees. November 1992.

Visits with Cooperators

Cooperator involvement in specific projects is maintained through personal contacts.

- Discussion of objectives, procedures, and feasibility for the herbaceous vegetation study with staff from Boise Cascade, Oregon Department of Forestry, Weyerhaeuser Company, and Starker Forests, Inc. D.E. Hanson, S.K. Knowe, W.G. Schneider, and M. Newton. September 1992.
- Reconnaissance and installation of plots for the herbaceous vegetation study - interaction with staff from Boise Cascade, Weyerhaeuser Company, and Starker Forests, Inc. CRAFTS Staff. June 1992 - April 1993.
- Reconnaissance and installation of growth monitoring plots in support of the Regional Vegetation Management Model - interaction with staff from Boise Cascade, International Paper, ITT-Rayonier, Lone Rock, PNW Research Station, Simpson Timber, Starker Forests, Inc, Weyerhaeuser Company, and Willamette Industries. CRAFTS Staff. June 1992 - April 1993.

ORGANIZATIONAL ACTIVITIES

Cooperators have direct participation in planning, installation, and review of CRAFTS research. During 1992-93 CRAFTS committees and subcommittees met four times.

Policy Committee Meeting

The Policy Committee meeting in July 1992 was led by Bill Voelker in his first year as Executive Officer. With the changes in staff, there was extensive discussion of the Coop's leadership and future directions. Steve Radosevich announced his plan for a joint Policy/Technical Committee scientific retreat to discuss the state of vegetation management. Other accomplishments included accepting the

CRAFTS Prospectus and Five-year Plan and the rescision of the 5% contingency fund requirement for the annual budget.

Scientific Retreat

In lieu of a fall Technical Committee meeting, a two-day retreat was held in November at Silver Falls Resort. This was a joint Policy-Technical Committee meeting. Steve Radosevich led the meeting which provided a forum for updating Cooperators on current research projects, discussing the future of PNW forestry, and how CRAFTS should be involved in that future. The Cooperators felt the need to be more regularly informed about the status of the various projects. This led to the development of the Quarterly Research Project Update newsletter. It was also decided that Steve Radosevich would chair a subcommittee to examine the future directions of CRAFTS. The subcommittee did not meet, however, as some members of the Policy Committee reconvened in February to discuss CRAFTS' direction and leadership with Logan Norris, the Forest Science Department Head.

Subcommittees

The Thinning Subcommittee met once, in April, to discuss possible thinning and release treatments for the Coast Range Competition Release Study. The committee developed a list of recommendations for this study to submit to the Policy Committee in June 1993.

The Advisory Subcommittee for the Regional Vegetation Management Model (RVMM) met once this year, in May, to technically review the RVMM Coast Range database and anticipated modeling approaches, the proposed Cascade Region dataset matrix, the RVMM demonstration model, and an approach to modeling the impacts of bigleaf maple clumps on the development of 20- to 60-year-old Douglas-fir stands. Members include: Chuck Chambers (WA-DNR), Bob Curtis (WA-PNW Res. Sta), Dave Hann

(OSU), Dave Hyink (Weyerhaeuser), Greg Johnson (IP), Steve Knowe (OSU), Dave Marshall (OSU), Dan Opalach (Simpson), Martin Ritchie (CA-PSW Res. Sta.) and Bob Shula (OSU). This subcommittee will continue its ongoing review of data acquisition and modeling methodology for the CRAFTS modeling effort.

PUBLICATIONS AND PRESENTATIONS

The CRAFTS staff prepared 42 presentations and publications for 1992-93 which are listed below:

Refereed Publications

Ballaré, C.L., A.L. Scopel, M.L. Roush, S.R. Radosevich, and R.E. Kendrick. 1992. Plant foraging for light in patchy canopies: The roles of light signals and phytochrome-B. *Functional Ecol.* (in press).

Harrington, T.B., J.C. Tappeiner II, and R. Warbington. 1992. Predicting crown sizes and diameter distributions of tanoak, Pacific madrone, and giant chinkapin sprout clumps. *West J. Appl. For.* 7:103-108.

Knowe, S.A. 1992. Predicting the impact of interspecific competition in young loblolly pine plantations with diameter distribution models. *For. Ecol. and Mgmt.* 55:62-82.

Knowe, S.A., T.B. Harrington, and R.G. Shula. 1992. Incorporating the effects of interspecific competition and vegetation management treatments in diameter distribution models for Douglas-fir saplings. *Can. J. For. Res.* 22:1255-1262.

Newton, M., E.C. Cole, M.L. McCormack, Jr., and D.E. White. 1992. Young spruce-fir forests released by herbicides II. Conifer response to residual hardwoods and overstocking. *North. J. Appl. For.* 9:130-135.

- Newton, M., E.C. Cole, and D.E. White. 1993. Tall planting stock for enhancing growth and domination of brush in the Douglas-fir region. *New Forests* 7:107-121.
- Newton, M., E.C. Cole, D.E. White, and M.L. McCormack, Jr.. 1992. Young spruce-fir forests released by herbicides I. Response of hardwoods and shrubs. *North. J. Appl. For.* 9:126-130.
- Radosevich, S.R., C.M. Ghera, and G. Comstock. 1992. Concerns a weed scientist might have about herbicide tolerant crops. *Weed Tech.* 6:635-639.
- Shainsky, L.J., M. Newton, and S.R. Radosevich. Effects of intra- and inter-specific competition on root and shoot biomass of young Douglas-fir and red alder. *Can. J. For. Res.* 22:101-110.
- Shainsky, L.J., and S.R. Radosevich. Mechanisms of competition between Douglas-fir and red alder. *Ecology* 73:30-45.
- Shainsky, L.J., B.J. Yoder, T.B. Harrington, and S.S. Chan. 1993. Physiological characteristics of red alder: Photosynthesis and water relations. *In* Hibbs, D.E. (ed.), *Biology of Red Alder*. Forest Research Laboratory, Oregon State University, Corvallis. (in press).

Progress Reports and Newsletters

- Hanson, D.E. 1993. Herbaceous vegetation study. CRAFTS Quarterly Research Project Update, January 1993.
- Hanson, D.E. 1993. Herbaceous vegetation study. CRAFTS Quarterly Research Project Update, April 1993.
- Hanson, D.E. 1993. Willamette National Forest forage seeding study. CRAFTS Quarterly Research Project Update, April, 1993

- Harrington, T.B., D.E. Hanson, S.A. Knowe, M. Newton, S.R. Radosevich, R.G. Shula, and W.G. Schneider. CRAFTS annual report 1991-1992. Forest Research Laboratory, Oregon State University, Corvallis. 28 p.
- Harrington, T.B., W.L. Voelker, G.P. Johnson, and R.L. Heninger. 1992. A prospectus of CRAFTS: Cooperative research and technology transfer in forest vegetation management. Forest Research Laboratory, Oregon State University, Corvallis. 14 p.
- Knowe, S.A. 1993. The COPE reforestation expert system. CRAFTS Quarterly Research Project Update, January 1993.
- Knowe, S.A. 1993. Effects of bigleaf maple clumps on growth of Douglas-fir. CRAFTS Quarterly Research Project Update, January 1993.
- Knowe, S.A. 1993. Effects of bigleaf maple clumps on growth of Douglas-fir. CRAFTS Quarterly Research Project Update, April 1993.
- Knowe, S.A., B.D. Carrier, and A. Dobkowski. 1993. Impacts of bigleaf maple sprout clumps on growth of young Douglas-fir. CRAFTS Technical Report. Forest Research Laboratory, Oregon State University, Corvallis. 13 p.
- Knowe, S.A. 1993. Proposal for relating light to stand attributes. CRAFTS Quarterly Research Project Update, January 1993.
- Shula, R.G., and S.A. Knowe. 1993. USFS Region 6 - Regional Vegetation Management Model. CRAFTS Quarterly Research Project Update, January, 1993.
- Shula, R.G., and S.A. Knowe. 1993. USFS Region 6 - Regional Vegetation Management Model. CRAFTS Quarterly Research Project Update, April, 1993.

- Schneider, W.G. 1993. BLM seedling mortality study. CRAFTS Quarterly Research Project Update, January, 1993.
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Proceedings and Abstracts

- Gjerstad, D.H., M.L. McCormack, Jr., and T.B. Harrington. 1993. Vegetation management practices in forests of the southeastern, northeastern and Pacific northwest United States and eastern Canada. *In Proc. International Conference on Forest Vegetation Management*, (in press). Auburn, AL.
- Hanson, D.E., and T.B. Harrington. 1993. Plant community response to hexazinone rate and formulation. *In Proc. Weed Sci. Soc. Am.* 33:48. Champaign, IL.
- Knowe, S.A. 1993. Development of a vegetation management model for Douglas-fir in the Pacific Northwest. *In Proc. South. Weed Sci. Soc.* 46: (in press). Charlotte, NC.

- Knowe, S.A., B.D. Shiver, and P.A. Banks. 1993. Direct effects of hexazinone and fertilization on loblolly pine seedlings. *In Proc. South. Weed Sci. Soc.* 46: (in press). Charlotte, NC.
- Knowe, S.A., and R.G. Shula. 1993. Stand- and tree-level approaches to modeling the effects of interspecific competition on early growth and development of Douglas-fir plantations. *In Proc. International Conference on Forest Vegetation Management*, (in press). Auburn, AL.
- Radosevich, S.R., and S.A. Knowe. 1993. Approaches and interpretation of experiments in forest vegetation management. *In Proc. International Conference on Forest Vegetation Management*, (in press). Auburn, AL.

Other Presentations

- CRAFTS: The Regional Vegetation Management Model.
R.G. Shula. Poster presented at the Annual Meeting of Western Mensurationists, Harrison, B.C. June 1992.
- CRAFTS: The Regional Vegetation Management Model.
CRAFTS Staff. Poster presented at Da Vinci Days Festival, Corvallis, Oregon. July 1992.
- CRAFTS: The Regional Vegetation Management Model.
D.E. Hanson. Poster presented at OSU College of Forestry Fernhopper Day, Corvallis, Oregon. May 1993.
- Impacts of competition control on forest growth and yield.
S.A. Knowe. Canadian Institute of Forestry, Rocky Mountain Section, Peace River, Alberta, Canada. October 1992.
- Prototype models for the RVMM. S.A. Knowe. USFS Regional Vegetation Management Model Steering Committee Meeting, Corvallis, OR. January 1993.

Sampling and data collection protocols in support of the development of the Regional Vegetation Management Model. R.G. Shula and S.A. Knowe. Meeting with George Leightner - Modeler, USFS, Portland, Oregon. June 1992.

Update: Development of the Coast Range RVMM Database. S.A. Knowe and R.G. Shula. USFS Regional Vegetation Management Model Steering Committee Meeting, Corvallis, Oregon. January 1993.

Vegetation management: The Oregon experience. S.R. Radosevich. Northern Interior Vegetation Management Assoc. Smithers, British Columbia, Canada. 1992.

FINANCIAL STATEMENT: SUPPORT RECEIVED

Cooperators

Boise Cascade Corporation		\$8,000
British Columbia Ministry of Forests		8,000
Bureau of Land Management		8,000
Cavenham Forest Industries		8,000
Champion International Corporation		8,000
International Paper Company		8,000
ITT-Rayonier, Inc.		8,000
Lone Rock Timber Company		3,000
Oregon Department of Forestry		8,000
Simpson Timber Company		8,000
Starker Forests, Inc.		4,000
Washington Department of Natural Resources		8,000
Weyerhaeuser Company		8,000
Willamette Industries, Inc.		8,000
	Subtotal	\$103,000
Forest Research Laboratory, Oregon State University	Subtotal	77,500
	Total	\$180,500

Other Sources¹

Regional Vegetation Management Model. USDA, Forest Service ² . (Radosevich and Knowe, 1991-92)		
Conifer seedling mortality in southwestern Oregon. BLM, Oregon State Office ² . (Knowe and Schneider, 1992-93)		
Reforestation decision system. COPE ² . (Knowe, 1992-93)		
Forage seeding in Oregon Cascades. USDA, Forest Service ² . (Radosevich and Hanson, 1992-93)		
	Total	\$231,833
	Grand Total	\$412,333

¹ Principle investigators in parentheses.

² Includes university overhead.

