HIGHLIGHTS 1989-90

This report describes the tenth year of activity by the CRAFTS Cooperative on forest vegetation management. The following are highlights of this past year:

- The 1990 Oregon Society of American Foresters Research Award was presented to Steve Radosevich and CRAFTS for outstanding contributions to forestry research.
- VEGPRO, a computer program to aid preparation of vegetation management prescriptions, was completed.
- Predictions from df et al., a young stand model for Douglas-fir, were refined with information from the Coast Range competition release study.
- An annotated bibliography on herbaceous vegetation in western U.S. forests was compiled.
- CLUMP, a computer model to predict Douglas-fir stand development in association with bigleaf maple, was constructed.
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INTRODUCTION

In the 10 years since the inception of the CRAFTS Cooperative, the science of vegetation management has gained widespread application in the Pacific Northwest. Today's young forests are managed using a variety of tools and techniques, some of which evolved from CRAFTS research. Recently, the focus of CRAFTS has broadened to include the design and construction of computer programs to select among vegetation treatments and predict growth characteristics of young forest stands. In the next decade, CRAFTS will continue to provide vegetation-management leadership in research, technology transfer, and idea-sharing in the Pacific Northwest.

CHANGES IN PERSONNEL

This past year, each of the Research Assistants with CRAFTS completed a doctorate degree in forestry, and all have new positions:

- Bob Wagner is now working as the Provincial Vegetation Management Specialist in Sault Ste. Marie, Ontario. Bob has been a dynamic member of the CRAFTS staff since the program was developed in 1980; we wish him well in his new career and thank him for furthering the success and mission of CRAFTS.

- Tim Harrington has assumed most of the technical responsibilities associated with the CRAFTS program. Tim steps into this position at a critical time to smooth transitions in the Cooperative's staff.

- Dan Opalach, formerly our forest modeler, is working as the Timberlands Planning Supervisor for the Simpson Timber Company in Arcata, California. Dan provided a great deal of quantitative expertise and impetus to CRAFTS, and we appreciate his contributions.

Bob Shula, previously of the Forest Research Institute of New Zealand and with over 10 years' experience modeling growth responses of radiata pine, will succeed Dan Opalach as
forest modeler for CRAFTS. Bob will continue developing the df et al. young stand model (see later in this report) when he comes on board as a Research Assistant in July 1990.

RESEARCH

In May 1990, the Oregon Society of American Foresters honored Steve Radosevich and the CRAFTS team for their outstanding contributions to forestry research. This award, given annually to an individual or group significantly benefiting forestry in the state of Oregon, acknowledges the research excellence of Steve and his associates in CRAFTS. In accepting the award, Steve thanked the CRAFTS membership for providing the support, insight, and flexibility essential to a research program of this caliber.

The breadth of the CRAFTS program is, in large measure, responsible for its success. CRAFTS addresses three key research areas of forest vegetation management:

• **Techniques for vegetation control**: testing new tools for reducing levels of vegetation that competes with young conifers.

• **Plant responses to vegetation control**: quantifying growth and survival responses to treatment of the various vegetation components in young forest stands.

• **Fundamental studies**: providing a detailed look at the mechanisms driving biological responses in managed stands.

**Techniques for Vegetation Control**

Vegetation managers need effective, inexpensive techniques for reducing competition levels in young forest stands. CRAFTS has two research projects underway to help managers select among the available treatments for controlling vegetation. In addition, Mike Newton and Elizabeth Cole provide the latest information on potential new uses for existing and experimental chemical treatments.
Computer-aided prescriptions for vegetation management

VEGPRO, the CRAFTS' computer program for selecting among vegetation control treatments according to stand characteristics and other specifications, was completed this year. The user manual and software for VEGPRO will be published through the Forest Research Laboratory, Oregon State University (OSU), and the package sold through the College of Forestry's Business Office. CRAFTS Cooperators will receive a complimentary copy of the VEGPRO user manual and software during early summer, 1990.

Fees collected from the sale of VEGPRO will be used to cover costs of publication, database maintenance, software updates, and CRAFTS administration associated with the project. Technical assistance for users of VEGPRO will be provided by a software-support company (computer-related questions) and faculty members (vegetation-management questions) in the College of Forestry.

Controlling bigleaf maple sprout clumps

The CRAFTS study to determine herbicide or cutting treatments for controlling bigleaf maple sprout clumps has been completed, and its results have been summarized in two CRAFTS Technical Reports (cited in previous CRAFTS Annual Reports). Bob Wagner is currently preparing a manuscript on this study for publication in a refereed journal.

In general, treatments which reduced crown volume 95% in first-year assessments provided excellent control of bigleaf maple for the duration of the study (Figure 1). Of the foliage treatments, only Arsenal® effectively controlled maple through the third year of the study. However, a number of basally applied treatments provided excellent control, including a 3% Garlon-4® spray in February, a full-strength spray of Weedone 170® in August, and thinline (full strength) applications of Garlon-4® in February, June, or August.

Elizabeth Cole and Mike Newton also are conducting research on herbicide treatments to control bigleaf maple. One-year-old maple sprout clumps were treated in 1988 with basal-
stem applications (fluroxypyr or triclopyr ester) or June foliage applications (imazapyr or glyphosate). One year later, the following treatments had less than 11% crown-volume recovery: April or June application of triclopyr at concentrations over 20%, June application of fluroxypyr at concentrations over 24%, and foliage application of imazapyr at 1.25% concentration. With triclopyr or fluroxypyr, any basal treatment that delivered more than 1.5 g active ingredient (ai) per 30 cm of clump diameter was effective at controlling maple.
Site preparation with glyphosate and imazapyr

A series of site-preparation trials was initiated by Elizabeth Cole and Mike Newton in a 2-year-old brushfield composed of vine maple sprouts and red alder seedlings. Treatments of glyphosate and imazapyr, alone or in mixture, each were applied in May, July, and August. August treatments provided the greatest crown-volume reduction for the two species. Mixing up to $0.14$ kg ai/ha imazapyr with glyphosate (at $0.6$ kg ai/ha) increased treatment efficacy substantially over that for glyphosate alone. The best treatments were either imazapyr alone ($0.14$ to $0.28$ kg ai/ha) or mixtures of glyphosate ($0.6$ to $1.1$ kg ai/ha) with imazapyr at rates of either $0.06$ (vine maple) or $0.14$ (red alder) kg ai/ha.

Comparison of two glyphosate formulations

The new formulation of glyphosate, Accord®, to which was added $1\%$ R-11 surfactant by volume, was compared to Roundup® for control of coastal vegetation at two rates ($0.84$ and $1.68$ kg ai/ha) and five monthly timings (June, July, August, September, and October). In this experimental trial, Elizabeth Cole and Mike Newton found no differences in vegetation control or Douglas-fir injury between the two glyphosate formulations. Control of salmonberry and thimbleberry increased with application rate; however, all treatments had less efficacy in July than in June, August, or September. Douglas-fir injury was significant during June through August independent of glyphosate formulation, especially at the higher rates.

Controlling snowbrush and manzanita in young ponderosa pine stands

Snowbrush ceanothus and greenleaf manzanita are common shrubs that compete with conifer seedlings in the Cascade Mountains. To determine strategies for controlling these species in ponderosa pine plantations, Elizabeth Cole and Mike Newton investigated both broadcast and directed-spray application techniques using a variety of herbicide treatments. For both application techniques, the best
treatments were imazapyr and fluoroxypr (Starane®) for snowbrush and manzanita, respectively. However, imazapyr caused severe injury to ponderosa pine despite minimal exposure of its foliage to the directed spray. Directed sprays of either fluoroxypr or triclopyr ester appear to provide the best control of manzanita and ceanothus, respectively, with minimal injury to pines. Currently, Starane® is not registered for forestry use.

Plant Responses to Vegetation Control

An integral part of CRAFTS research has centered on characterizing forest-stand responses to vegetation management. The second decade for CRAFTS should provide opportunities to test and refine many of the vegetation-management concepts currently being developed.

CLUMP: Competition Losses Using Maple Projections

Sprout clumps of bigleaf maple often occur at low densities or as isolated stands within Douglas-fir plantations, which complicates the strategies available to managers for vegetation control. CRAFTS is using an integrated approach of growth modeling and herbicide research to quantify the effects of treated and untreated bigleaf maple on development of Douglas-fir stands. This year, as part of that approach, an initial version of CLUMP—a growth model for projecting height and crown development of neighboring Douglas-fir and bigleaf maple—was constructed. The model utilizes growth equations for bigleaf maple, engineered by Tim Harrington, to predict overtopping cover for neighboring Douglas-fir. Competitive effects of overtopping cover on Douglas-fir height growth are simulated by the same mathematical routines as in the df et al. young stand model (see later in this report).

One of CLUMP’s features is simulation and computer-screen display of an “aerial view” of a Douglas-fir/bigleaf maple stand as it develops through time. Over the first decade, the maple are randomly scattered among the Douglas-fir (Figure 2a). If a Douglas-fir sapling is heavily overtopped (greater than
80% maple cover) for 10 consecutive years, the tree dies (Figure 2b). At stand age 25 to 30 years, all surviving Douglas-fir are taller than the bigleaf maple (Figure 2c). This modeling approach provides a method for quantifying reductions in both height growth and density of Douglas-fir stands—important determinants of wood volume yield.

Figure 2. "Aerial view" of a developing mixed Douglas-fir/bigleaf maple stand at ages (a) 10, (b) 20, and (c) 30 years, as simulated by CLUMP.
As recommended by the CRAFTS Technical Committee, CLUMP will be limited to stand simulations up to the stage in which surviving Douglas-fir are dominant over the bigleaf maple. The model then will output a list of heights for the surviving Douglas-fir that can be used in other stand simulators, such as DFSIM or SPS, to compare Douglas-fir wood yields in association with various densities and sizes of bigleaf maple.

An important feature to be added before model completion in the coming year is the effect of vegetation management on stand development. Results from CRAFTS research on treatments to control bigleaf maple (described previously in "Techniques for Vegetation Control") will be utilized in CLUMP to estimate rates of sprout-clump recovery and their potential competitive effects on associated Douglas-fir.

**Coast Range competition release study**

Now in its ninth year, the CRAFTS Coast Range study on competition release treatments has provided a comprehensive database with which to evaluate accepted vegetation-management practices in the Pacific Northwest. Data from this study have been used to test and fit models for the df et al. young stand model.

Each year since the study was initiated, CRAFTS staff have maintained the complete-removal treatment using herbicide or manual techniques as required. In spring 1989, five of the six sites received their last complete-removal treatment—on these sites, Douglas-fir crown closure had eliminated nearly all of the competing shrub and herbaceous vegetation. This coming year, a standard protocol will be designed for precommercial thinning of trees in the experimental plots. Growth measurements for the tenth year after treatment will be collected during the summers of 1991 and 1992.

**df et al.: the CRAFTS/COPE young stand model**

With financial assistance from the Coastal Oregon Productivity Enhancement (COPE) program and the
Forest Service regional model

A new project, being developed by Steve Radosevich, soon will be underway to construct a comprehensive vegetation-management model for Region 6 of the USDA Forest Service. This 5-year undertaking, requiring a budget of almost 1 million dollars, will integrate CRAFTS' computer technology in VEGPRO and df et al. into a single software package capable of providing site-specific analyses of Douglas-fir stand development for various vegetation-management scenarios. A primary objective is to produce assessments that can be used for prescribing treatments according to the guidelines established in the recent Environmental Impact Statement on Managing Competing and Unwanted Vegetation.

VEGPRO's treatment database will be greatly expanded in the regional model to include Forest Service data on chemical, mechanical, and manual techniques for managing competing vegetation. The model's scope will encompass Douglas-fir
vegetation types in the Coast, Cascade, and Siskiyou Mountain Ranges.

Later this year, a project scientist and research assistant will be hired to initiate and direct this project. David Hann also will be an active participant.

**Herbaceous vegetation bibliography**

This year, CRAFTS compiled an annotated bibliography on herbaceous vegetation in forest stands of the western U.S. to summarize current knowledge and help identify potential information gaps that might spur future CRAFTS research.

Donna Loucks, Forestry Information Specialist, was contracted to perform the computer search of recent literature (after 1970) on the following three topics: (1) effects of herbaceous vegetation on forest stand development, (2) management of herbaceous vegetation, and (3) relationships of herbaceous vegetation to soil biological and physical characteristics. Abstracts in the bibliography, grouped according to these three topics, can be referenced by a subject index.

The bibliography will be published this summer through OSU's Forest Research Laboratory and copies distributed to CRAFTS Cooperators.

**Fundamental Studies**

Although not directly financed by CRAFTS, these fundamental research projects are strongly associated with the more applied research being conducted by the Cooperative.

**Douglas-fir/red alder interactions**

This year, a study to characterize possible interactions between Douglas-fir and red alder entered its fifth year since planting. An important objective of the research is to determine how the timing at which red alder is introduced or removed affects outcomes in development of Douglas-fir stands in the Coast and Cascade Ranges and Puget Sound area. In this fifth
year of the study, red alder will be either planted or removed in selected Douglas-fir plots, and the resulting course of stand development followed for 10 or more years.

Preliminary observations of natural stands adjacent to the study areas suggest that after a 5-year establishment period, Douglas-fir are capable of height growth rates that would allow them to compete effectively with newly introduced red alder, especially on sites in the Cascades or the Puget Sound area, where Douglas-fir is better adapted than red alder to dry soil conditions.

**Responses of Douglas-fir and red alder to resource availability**

In doctoral research being conducted by Sam Chan, resource availability was experimentally manipulated around individual saplings of Douglas-fir and red alder. For three growing seasons, saplings were exposed to differing light levels (15% of full sunlight or full sunlight) with or without growing-season watering treatments.

For both species, total biomass was more sensitive to levels of light than to soil water (Figure 3). Red alder growth was affected by both light and soil-water availability; however, for Douglas-fir, the effects of limited water availability on tree growth were only evident when light was limited. Soil water was probably less important than light for biomass development because, in the study, trees of both species were grown in a deep Willamette Valley soil with a high water-holding capacity.

Sam found that when saplings of both species were watered during the growing season, they depleted 3 to 4 times more moisture than unwatered saplings. Although red alder had 4 to 9 times the biomass of Douglas-fir (Figure 3), it depleted only twice as much soil water. These results provide a mechanistic explanation for the strong competitiveness of red alder with Douglas-fir—for saplings of the same age, red alder are more efficient than Douglas-fir at converting water and light to biomass.
Completed Doctoral Studies

(see later, "Graduate Theses," for complete citations)

Interspecific competition with Douglas-fir in the Coast Range

Bob Wagner examined the effects of interspecific competition in the Oregon Coast Range on growth of planted Douglas-fir and the availability of soil water and light. By experimentally manipulating cover of shrub and herbaceous
species around individual Douglas-fir, Bob was able to quantify the influences of vegetative cover for various heights or horizontal distances from a given tree. Using a regression analysis, Bob found that vegetative cover above 50 and 100% of tree height most strongly limited the annual growth in stem basal area and height, respectively, of Douglas-fir. These results, which form the basis for competition effects in df et al. (discussed previously), suggest that in the Coast Range, shrub and herbaceous vegetation have similar competitive influences on basal area growth of Douglas-fir, whereas overtopping hardwoods and shrubs impose the greatest limitations on height growth of Douglas-fir.

In each year following the removal of both shrub and herbaceous vegetation, basal area growth of Douglas-fir increased exponentially over that of trees in herb-dominated plots. In contrast, significant negative correlations between Douglas-fir height increment and vegetative cover were not detected until the third year of the study. Bob found that herbaceous vegetation did not limit light availability to neighboring Douglas-fir. However, for the same amount of cover, herbaceous species reduced soil-water availability at the 30-cm depth more than shrub species.

Reproductive and growth characteristics of salmonberry and thimbleberry

Bruce Maxwell used two approaches to characterize reproduction and growth of salmonberry and thimbleberry. In the first approach, he compared the relative importance of reproduction from seeds versus sprouting rhizomes at several sites in the Oregon Coast Range. Bruce found average survival of plants grown from seed to be only 32 and 44%, respectively, for salmonberry and thimbleberry; in contrast, average survival of sprouts was 77 and 100%, respectively.

In the second approach, Bruce used data from his field studies to develop a model that predicts individual plant and population growth. His model demonstrated that prolific bud production coupled with high levels of sprout survival ensure that populations of salmonberry and thimbleberry are
dominated by sprouts rather than plants grown from seed. Model simulations also indicated that recovery of salmonberry from manual cutting was lowest when cutting occurred during the plant's reproductive stage in early summer.

Growth, morphology, and physiology of Douglas-fir in competition with tanoak

As part of a Fundamental FIR (Forestry Intensified Research) project, Tim Harrington installed a gradient of tanoak cover in two existing Douglas-fir plantations to describe competitive relationships between hardwoods and conifers in southwestern Oregon. During a 6-year monitoring period, Tim found a strong negative relationship between Douglas-fir growth rate and initial tanoak cover. This information recently was combined with other FIR data on Pacific madrone and chinkapin to develop a computer program (PSME: Plantation Simulator-Mixed Evergreen) that predicts early growth of mixed Douglas-fir/hardwood stands.

To describe basic aspects of competition, Tim conducted morphological and physiological studies. In his research on morphology, he found that competition restricted the number of needle primordia produced within Douglas-fir buds. In addition, terminal bud size was shown to be a strong indicator of next year's height growth for Douglas-fir. In his research on physiology, Tim found that photosynthesis rates of Douglas-fir growing in the shade of tanoak were light-limited throughout the entire year.

TECHNOLOGY TRANSFER

CRAFTS disseminates its research information to Cooperators and others in a variety of ways.

Technical Reports to Cooperators

Three publications and 17 presentations in 1989-90 provided the Technical Committee with information on current research and approaches in vegetation management:
Publications:


• Interspecific competition in young Douglas-fir plantations of the Oregon Coast Range. R.G. Wagner.

Presentations:


• OSU studies on herbicide efficacy. M. Newton. April 1990.

• COPE research on shrub and hardwood ecology in the Oregon Coast Range. J.C. Tappeiner II and J.C. Zasada. April 1990.

• Update on Arsenal® trials. B. Alber. October 1989.


A complete list of publications and presentations by CRAFTS personnel is provided later in this report.

Visits with Cooperators

CRAFTS personnel often make direct contacts with field foresters of cooperating organizations. Such contacts ensure direct application of research results.


Continuing Education

This year, CRAFTS staff were directly involved in instruction and field demonstrations for three workshops on forest vegetation management:

- Forest Vegetation Management Workshop, Oregon State University, Corvallis, Oregon. January 1990. With the help of five facilitators, Tim Harrington led workshop participants in an exercise he designed for improving prescription-writing skills in vegetation management.

- Forest Vegetation Management Workshop, FIR program, Grants Pass, Oregon. November 1989. Tim Harrington and Mike Newton each presented the latest results from several FIR studies on how hardwood and shrub competition affects the growth, morphology, and physiology of Douglas-fir. In addition, Tim and Mike provided on-site research reports during a field tour of several Fundamental FIR sites.


Special Publications

Fire compendium

A new book entitled Natural and Prescribed Fire in Pacific Northwest Forests (Figure 4) is now available for purchase from Oregon State University Press. Edited by Jack Walstad, Steve Radosevich, and Dave Sandberg, this book provides the perspectives, scientific accounts, and executive summaries of over 25 experts on the history, ecological effects, and management uses of fire. This COPE project was originally inspired by the 1986 CRAFTS Technical Report, Prescribed Fire in Pacific Northwest Forests: An Annotated Bibliography.
Figure 4. A new book on fire in managed and unmanaged forests of the Pacific Northwest.

Complimentary copies were sent to the CRAFTS Policy Committee in April 1990.

**Animal-damage bibliography**

A comprehensive collection of pertinent literature references and abstracts on animal damage soon will be available. Entitled *A Silvicultural Approach to Animal Damage Management in Pacific Northwest Forests: An Annotated Bibliography*, this book will be printed early this summer as a General Technical Report from the USDA Forest Service, Pacific Northwest Research Station. It offers source material for a future reference book that will synthesize silvicultural approaches to animal-damage management. Hugh Black, Steve Radosevich, and Jack Walstad are directing this
synthesis textbook which, like the recent book on natural and prescribed fire, will provide comprehensive summaries and forest-management perspectives.

ORGANIZATIONAL ACTIVITIES

Cooperators have direct participation in the planning, installation, and review of CRAFTS research. During 1989-90, CRAFTS committees and subcommittees met four times.

Policy Committee

The Policy Committee met in June 1989 on OSU Research Policy Day to review current and proposed research. Tom Terry (Weyerhaeuser Company), Executive Officer, gave a report on the findings of the Research Directions Subcommittee, which had recommended approval of three research proposals. The Policy Committee approved funding for these projects, which included a vegetation management treatment information network, further development and verification of the CRAFTS/COPE young stand model, and a study on effects of herbaceous vegetation on Douglas-fir. Tharon O’Dell (Simpson Timber Company) was elected to serve as the Committee’s Executive Officer during 1989-90. CRAFTS thanks Tom Terry for serving as Executive Officer for the Committee during 1987-89.

Technical Committee

The Technical Committee met in October 1989 and April 1990. At the October meeting, held in Grants Pass, Oregon, progress reports were presented on three modeling projects currently being developed by the Cooperative. At the April meeting, the Committee discussed potential guidelines for completing the bigleaf maple model (CLUMP) and possible research approaches for the new CRAFTS study on herbaceous vegetation. In addition, Cooperators from two state
agencies shared perspectives on their forage-seeding programs.

Field tour of FIR study sites

A feature of the October 1989 Technical Committee meeting was a field tour of FIR research sites in the Grants Pass area, hosted by Ole Helgerson, Adaptive FIR Scientist. Cooperators visited several studies that are testing regeneration and vegetation-management techniques for establishing Douglas-fir and ponderosa pine plantations. In addition, Ole presented a new slide-tape program describing the history and progress of FIR, whose work over the past decade has focused on reforestation of hot, dry sites typical of southwestern Oregon.

Joint meeting with Auburn cooperative

Over 30 members of the Silvicultural Herbicide Cooperative at Auburn University, Auburn, Alabama, will join us in Corvallis for a joint Technical Committee meeting in fall 1990 (tentative dates, September 24-28). On this occasion, our southern associates will have a chance to learn about Pacific Northwest plant species and vegetation management practices, as well as to visit and review field research sites. The joint meeting will provide a unique opportunity to share experiences and gain new perspectives.

Herbaceous Vegetation Subcommittee

The Herbaceous Vegetation Subcommittee met for the first time in April 1990 to review current knowledge about the effects of herbaceous vegetation on young Douglas-fir and to refine approaches for the upcoming research project. An additional meeting of this Subcommittee is planned for summer 1990 to develop protocols and methods for site selection and treatments, which will be presented at the fall 1990 meeting of the Technical Committee. Tim Harrington and Jerry Chetock (Oregon State Department of Forestry) are co-chairing this Subcommittee.
CRAFTS personnel prepared the following publications and presentations during 1989-90:

Refereed Publications


Progress Reports and Newsletters


Proceedings and Abstracts


Graduate Theses


Simard, S. W. 1989. Competition among lodgepole pine seedlings and plant species in a Sitka alder-dominated


Other Presentations


VEGPRO: forest vegetation management prescription optimization and information system. T.B. Harrington. Silviculture Institute, College of Forestry, Oregon State University, Corvallis, Oregon. May 1990.

An overview of the CRAFTS program. T.B. Harrington. Poster presented for Earth Day program, College of Forestry, Oregon State University, Corvallis, Oregon. April 1990.


Forest vegetation management: where have we been and where are we going? R.G. Wagner. Seminar, Department of Forest Science, Oregon State University, Corvallis, Oregon. March 1990.


FINANCIAL STATEMENT:
SUPPORT RECEIVED

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Other Sources¹

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¹Project leaders in parentheses.
²Includes university overhead.
WARNING: This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and Federal agencies before they can be recommended.