



CRAFTS

Annual Report
1988-89

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CRAFTS

Coordinated Research On
Alternative Forestry
Treatments & Systems

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Forest Research Laboratory
Oregon State University

HIGHLIGHTS 1988-89

This report describes the ninth year of activity for the CRAFTS Cooperative on forest vegetation management. The year's highlights include:

- Developing a computer program (VEGPRO) to assist foresters with vegetation management prescriptions
- Making substantial progress on a growth model (df et al.) for young Douglas-fir plantations
- Completing a computer program (ICIPS) for predicting levels of competition in Douglas-fir plantations
- Beginning to develop a computer program (CLUMP) for managing bigleaf maple clumps
- Collecting third- and final-year data from a study comparing methods for controlling bigleaf maple sprout clumps

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English/metric conversions

1 in. = 2.54 cm

1 ft = 0.3048 m

1 ft² = 0.0929 m²

1 ac = 0.4047 ha

1 lb = 0.4536 kg

1 gal. = 3.7853 L

INTRODUCTION

Successful reforestation of commercial forest lands in the Pacific Northwest requires effective management of associated competing and unwanted vegetation. The CRAFTS Program—Coordinated Research on Alternative Forestry Treatments and Systems—was formed in 1980 to advance the practice of forest vegetation management in the region. Centered at Oregon State University, CRAFTS conducts research, communicates its findings through publications and presentations, and provides a forum for information exchange among its Cooperators. The following report describes CRAFTS' accomplishments during 1988-89.

RESEARCH

Four areas of CRAFTS research address important aspects of forest vegetation management:

- *Efficacy testing of tools*: examines new tools and techniques for managing vegetation
- *Crop tree and site responses*: quantifies the effects of vegetation management on crop tree survival and growth
- *Commercial forest yields*: models the long-term silvicultural and economic impacts of vegetation management
- *Fundamental studies*: improves our basic understanding of the systems being managed.

Efficacy Testing of Tools

Foresters must have effective and cost-efficient tools to manage vegetation. Thus, CRAFTS examines promising new tools and techniques involving chemical, manual, mechanical, and biological methods and fire. Organizing available information on the use of these methods also is an objective of this research.

Controlling bigleaf maple sprout clumps

Third- and final-year data were collected from a study comparing various methods to control sprout clumps of bigleaf maple in young Douglas-fir stands. The study, directed by Bob

Wagner, was installed in 1985 on six sites provided by Cooperators in Oregon and Washington. Six herbicide products (Garlon 4®, Garlon 3a®, Roundup®, Escort®, Arsenal®, and Weedone 170®) were applied at three times of year (June, August, and February) by each of three methods: (1) foliar spray, (2) basal spray, and (3) cut surface (herbicide applied to the cambium of a freshly cut stump). Manual cutting without herbicides also was tested.

Results collected this year revealed that bigleaf maple clumps can recover to pretreatment size in most cases within 3 years. Only Arsenal® foliar sprays, Garlon 4® basal sprays, and Garlon 3a® cut-surface treatments have been able to sustain greater than 80% control through the third year. Patterns of maple clump recovery indicate that the degree of long-term (>3 years) control is related to the degree of injury in the first year. Long-term efficacy was only provided by treatments that yielded more than 95% control in the first year.

Information system for prescribing vegetation management treatments

VEGPRO, a computer program for prescribing forest vegetation treatments, was developed this year under the direction of Bob Wagner. The program is designed to handle site preparation, release, and individual plant treatments for (1) deciduous woody vegetation in the Coast and Cascade Ranges, (2) mixed sclerophyll vegetation in southwestern Oregon and northern California, and (3) herbaceous vegetation in the Coast and Cascade Ranges. VEGPRO contains current information on both herbicide and manual treatments for forest vegetation in the Pacific Northwest. However, the user can modify the database to conform to local conditions or update it with new information.

Target-species composition and treatment costs are entered into VEGPRO for a particular forest site. The program then uses a treatment-efficacy database and user-determined selection criteria to choose the best treatment for the situation (Figure 1). Treatments are ranked on the basis of amount of vegetation remaining after treatment, treatment costs, and cost

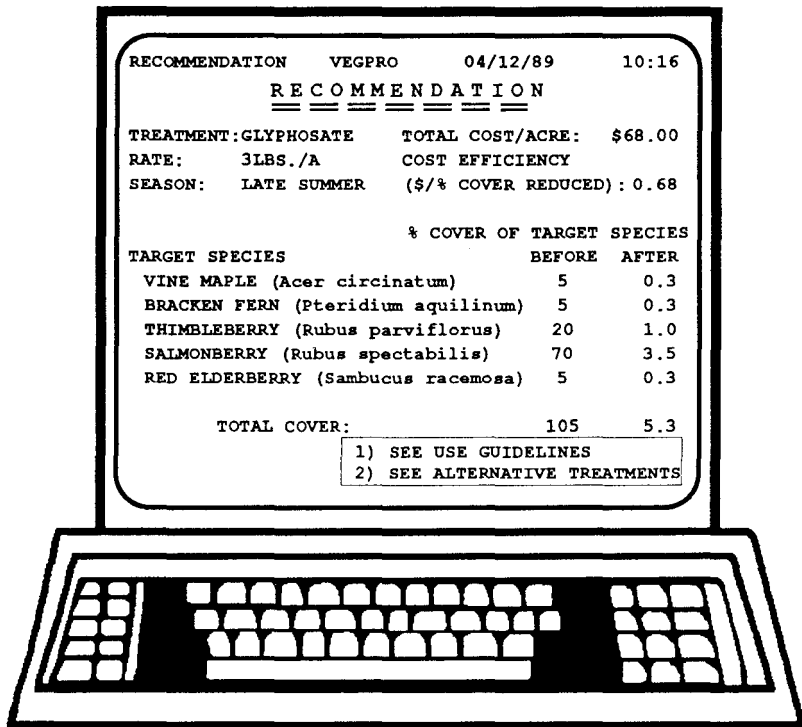


FIGURE 1. VEGPRO recommendation "window" displaying the best treatment for a particular situation.

efficiency. In addition, a guideline "window" describing application specifications, herbicide characteristics, and registration status is available. A printout of all information related to the computer run can be generated once the user is finished.

A pre-release version of VEGPRO was completed and sent to several CRAFTS Cooperators and other vegetation-management experts for technical review. Program modifications based on this review are underway. Current plans call for production, marketing, and distribution of VEGPRO by a commercial software company.

Auxiliary studies for assessing tool efficacy

CRAFTS is working closely with Mike Newton and associates on the following treatment screenings.

Herbicides for herbaceous weed control in young conifer plantations in coastal Oregon

Several herbicide treatments (including combinations of 2,4-D, atrazine, dalapon, clopyralid, hexazinone, sulfometuron, and glyphosate) were tested for early-season competition release on a 2-year-old Douglas-fir plantation. Herbaceous weeds targeted for control included forbs and grasses, primarily Australian fireweed and velvet grass.

Forb cover was reduced with all treatments; clopyralid, sulfometuron, and 2,4-D ester were most effective, diminishing forb cover to less than 4%. Grass cover was reduced with all treatments except 2,4-D ester and clopyralid.

Most treatments did not injure Douglas-fir. Less than 4% of the seedlings had minor injury to foliage, including stunting and chlorosis. Most injury was associated with the 2,4-D treatments.

Herbicides for forest site preparation in coastal Oregon

Combinations of 2,4-D ester, triclopyr, metsulfuron, imazapyr, and glyphosate were applied in June on a coastal Oregon site to determine their potential for site preparation. Dominant vegetation included red alder, vine maple, salmonberry, and hazel.

Most treatments provided good shrub and hardwood control after 1 year. Red alder was controlled with all treatments except metsulfuron, salmonberry with all treatments but 2,4-D and triclopyr. All combinations provided excellent control of hazel.

Imazapyr stem injection for hardwood control

The efficacy of different imazapyr treatments for stem injection on bigleaf maple, red alder, Pacific madrone, and white oak is being evaluated. Treatments were applied in December and June with "hack and squirt" stem injection at four herbicide concentrations (0.02, 0.06, 0.12, and 0.24 kg/L) and three spacings of cuts around stems (7.6, 15.2, and 22.9 cm).

All treatments were effective in reducing the crown cover and vigor of the four species. For bigleaf maple, June applications were better than December applications, and the higher concentrations and closest spacings provided the greatest control. For red alder, spacing was more important than season of application, but even the widest spacings at low concentrations were effective. For Pacific madrone, December applications resulted in greater crown reduction and mortality than June applications. For white oak, concentrations of 0.06 kg/L were effective at all spacings and seasons.

Fluroxypyr for ponderosa pine release

The potential use of fluroxypyr in forestry is being examined on the eastern slope of the Oregon Cascades to determine (1) pine tolerance to fluroxypyr and triclopyr spray mixes, (2) efficacy of fluroxypyr on greenleaf manzanita and snowbrush ceanothus, and (3) whether adding sulfometuron can enhance the effects of fluroxypyr.

First-year results indicated that fluroxypyr caused less injury to pine than did triclopyr but was not effective in controlling ceanothus. Adding sulfometuron to fluroxypyr improved ceanothus control. Manzanita control with fluroxypyr was similar to that with triclopyr. Sulfometuron alone was not effective on manzanita or ceanothus, and caused little or no injury to pines.

Crop Tree and Site Responses

CRAFTS emphasizes long- and short-term studies on crop tree performance resulting from the management of competing vegetation. Current experiments are identifying both direct and indirect effects of vegetation treatments on conifer survival and growth, as well as changes in environmental resources or conditions that result from manipulating vegetation.

Coast Range Competition Release Study

The Coast Range Competition Release Study is the oldest CRAFTS study. Directed by Tim Harrington and Bob Wagner, it is now in its eighth year.

Fifth-year results reveal that when both shrubs and herbaceous vegetation are removed completely, Douglas-fir stem diameters are nearly double those in the other treatments (Figure 2A). Although height differences are not as large, Douglas-fir in the complete-removal treatment are about 3 feet (0.91 m) taller than those in the untreated control (Figure 2B).

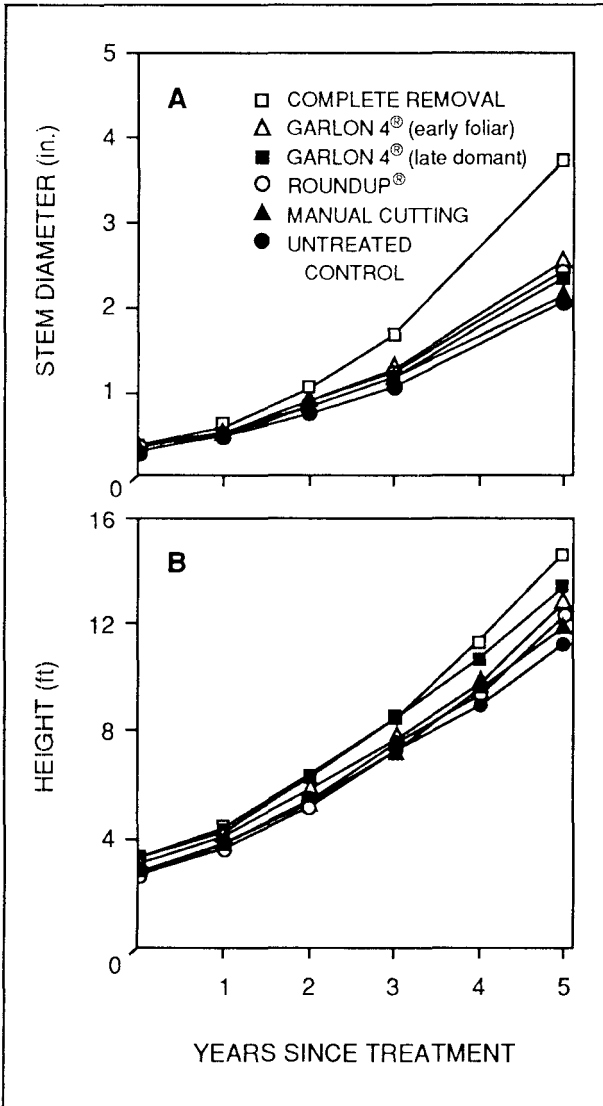


FIGURE 2. Douglas-fir stem diameter (A) and height (B) following six competition-release treatments in the Oregon and Washington Coast Range.

Operational herbicide (Roundup® and Garlon 4®) and manual-cutting treatments have not substantially increased stem diameter or height over those of the untreated control. Douglas-fir survival did not differ among any of the treatments.

Data from this experiment were used this year to verify the ICIPS model for projecting interspecific competition (see following subsection) and are being used to develop the **df et al.** model for estimating growth in young Douglas-fir stands (see later in this report).

Interspecific competition index for the Siuslaw National Forest

To provide a practical, quantitative approach for making competition-release decisions in young Douglas-fir plantations, Bob Wagner and Steve Radosevich continued to develop an index of interspecific competition for the Siuslaw National Forest. Construction of regression models describing the relation between the index and Douglas-fir growth also is a focus of this project.

Since foresters also need a means to predict future competition-index values to circumvent potential stand losses from competing vegetation, efforts this past year were aimed at devising a technique to estimate growth of the four most abundant shrub and hardwood species in young Douglas-fir plantations of the Oregon Coast Range. The result is an interactive computer program called ICIPS (Interspecific Competition Index Projection System), which can project the height and cover dynamics of salmonberry, thimbleberry, red alder, and vine maple around individual Douglas-fir trees for their first 20 years. Development of ICIPS was coordinated by Bob Wagner, Dan Opalach, Bruce Maxwell, Jimmy Dukes, and Steve Radosevich.

Data from the previously mentioned CRAFTS Coast Range Competition Release Study were used to verify the model to ensure that ICIPS projections are consistent with conditions actually encountered in the Oregon Coast Range. Model validation with reforestation survey data from the Siuslaw National Forest also indicated that ICIPS projections are reasonable for the species considered.

The ICIPS computer program and a report on this project were distributed to Cooperators this year. ICIPS also is serving as a component of the **df et al.** model now under development (see later in this report).

Effects of shrubs and herbs on conifer regeneration on high-elevation sites of south-central British Columbia

An experiment conducted by Dave Coates, under the joint direction of Bill Emmingham and Steve Radosevich, is directed at assessing the impact of woody and herbaceous vegetation on the survival and growth of Engelmann spruce and lodgepole pine in the Engelmann spruce-subalpine fir zone of south-central British Columbia. Growth of individual spruce and pine seedlings was decreased by both shrubs and herbs. Soil moisture, air temperature, and light levels were major environmental factors inhibiting conifer seedling performance beneath shrub canopies.

Competition among lodgepole pine, Sitka alder, and other plant species in the southern interior of British Columbia

Two experiments, conducted by Suzanne Simard under the direction of Steve Radosevich, were established in the southern interior of British Columbia to determine the influence of Sitka alder and herbaceous plants on lodgepole pine performance. In the first experiment, seedling lodgepole pine were planted into artificially created shrub and herb densities. Lodgepole survival rates were not significantly affected by vegetation density. However, seedling size decreased as shrub and herb density increased. In the second experiment, competition between 8-year-old naturally regenerated lodgepole pine and plants in the undisturbed community was examined. Two vegetation types were identified, that dominated by pinegrass and that dominated by Sitka alder. Lodgepole performance was inhibited more by interspecific competition in the pinegrass type than the Sitka-alder type.

Causes of Douglas-fir mortality in pinegrass-dominated communities of central British Columbia

Several experiments were conducted in central British Columbia to determine why Douglas-fir seedlings performed poorly on sites dominated by pinegrass. The experiments, conducted by Alison Nichol森 under the direction of Steve Radosevich, showed that Douglas-fir survival on such sites was influenced by an array of climatic and microenvironmental factors which combined to affect both the seasonal frequency and duration of water stress in the seedlings. Environmental factors other than pinegrass may currently be more important to Douglas-fir regeneration in this region.

Commercial Forest Yields

Linking the effects of competing vegetation on young forest plantations with changes in long-term stand development is important to assessing the benefits of vegetation management. Thus, CRAFTS has focused on developing models that can predict the effects of vegetation management on long-term forest yields. Two modeling projects are underway.

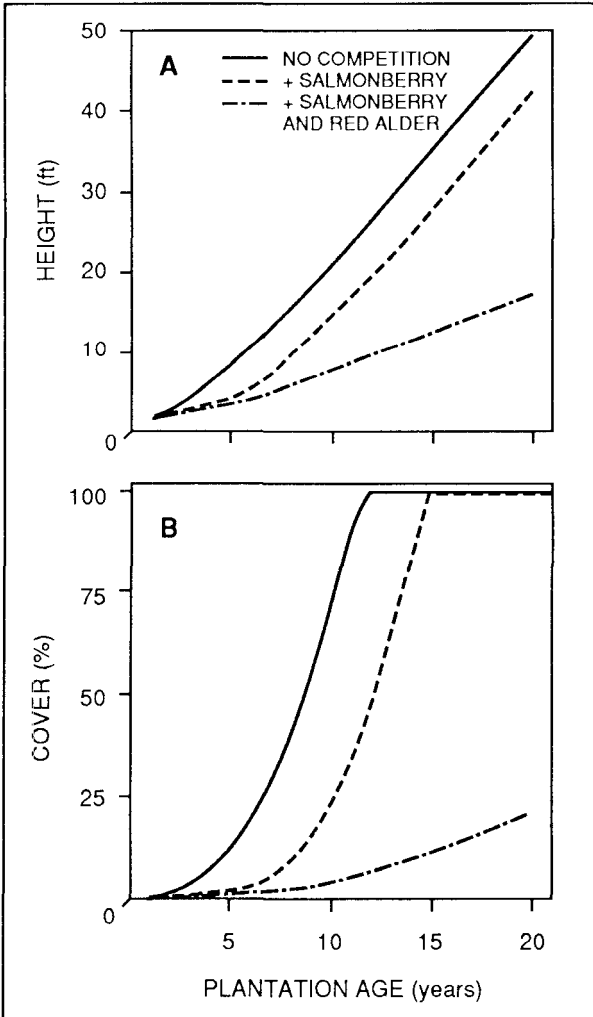
CRAFTS/COPE Young Stand Model

In 1987, the CRAFTS Cooperative and the COPE (Coastal Oregon Productivity Enhancement) Program jointly initiated a study to develop a growth model for young Douglas-fir plantations. A model is needed to quantify the impact of competing vegetation and release treatments on the long-term development of Douglas-fir stands. Under the direction of Dan Opalach, this project also will identify gaps in the existing data and can be used to guide future research.

A preliminary version of the model, called **df et al.** (Douglas-fir and others), has been completed for five species—Douglas-fir, red alder, vine maple, salmonberry, and thimbleberry. This version predicts the height and cover development of any combination of these species on a circular 1/300-acre (0.001-ha) plot.

During the past year, **df et al.** was fit to data from the previously mentioned Coast Range Competition Release Study to estimate unknown parameters and to test the model's predictive ability. Statistics reveal that the model accounts for much of the variation in the data.

The current version of **df et al.** can simulate the effects of competing vegetation in a coastal Douglas-fir plantation for its first 20 years. For example, dominant Douglas-fir can attain a height of 49 feet (14.9 m) at age 20 years (Figure 3A) and



*FIGURE 3. Height (A) and cover development (B) of coastal Douglas-fir competing with woody vegetation, as simulated by the current version of **df et al.***

crown closure at age 12 (Figure 3B) in the absence of competition from woody vegetation. If salmonberry dominates the site in the first year, Douglas-fir attain a height of 42 feet (12.8 m) by age 20, and crown closure is delayed until age 15. If red alder also invades, Douglas-fir attain a height of only 17 feet (5.2 m), and crown closure is delayed beyond age 20. These simulations assume a site index (total height at breast-height age 50) of 125 feet (38.1 m) and a Douglas-fir density of 300 trees/acre (121 trees/ha).

During the coming year, functions for stem diameter, Douglas-fir mortality, and impact of competition from herbaceous vegetation will be added, and the model will be enhanced to simulate the effects of competition-release treatments. Plans also include using outputs from **df et al.** as inputs to models for older stands to evaluate the potential long-term economic effects of vegetation management.

Effects of bigleaf maple on Douglas-fir yield

CRAFTS has several research projects underway to determine the economic threshold for controlling bigleaf maple sprout clumps in young Douglas-fir stands. In addition to a study comparing various control strategies (see earlier, "Efficacy Testing of Tools"), this three-phase project is directed at quantifying the influence of bigleaf maple density on Douglas-fir stand development.

Phase I: predicting crown development of bigleaf maple sprout clumps

Factors affecting the early development (1 to 10 years) of bigleaf maple sprout clumps were described by Tim Harrington and Bob Wagner in the CRAFTS Annual Report 1987-88. Both stump and site characteristics were found to have a strong influence on the early height and crown-width development of maple clumps. Data from this study were used to construct models for predicting the growth of bigleaf maple clumps. These growth models are currently being incorporated into the computer program under development in Phase III.

Phase II: impacts of bigleaf maple clumps on 20- to 60-year-old Douglas-fir stands

The growth models for bigleaf maple height and crown width, developed in Phase I, were extended to 20- to 60-year-old Douglas-fir stands in Phase II. The change in Douglas-fir wood volume at increasing distances from the center of bigleaf maple clumps provided the basis for analysis. Bob Wagner and Tim Harrington conducted this study in five stands on Cooperator lands in Oregon and Washington.

Preliminary analysis of Douglas-fir basal area indicates that the "hole" created by bigleaf maple can be prominent in 20- to 35-year-old stands (Figure 4). As unthinned stands mature,

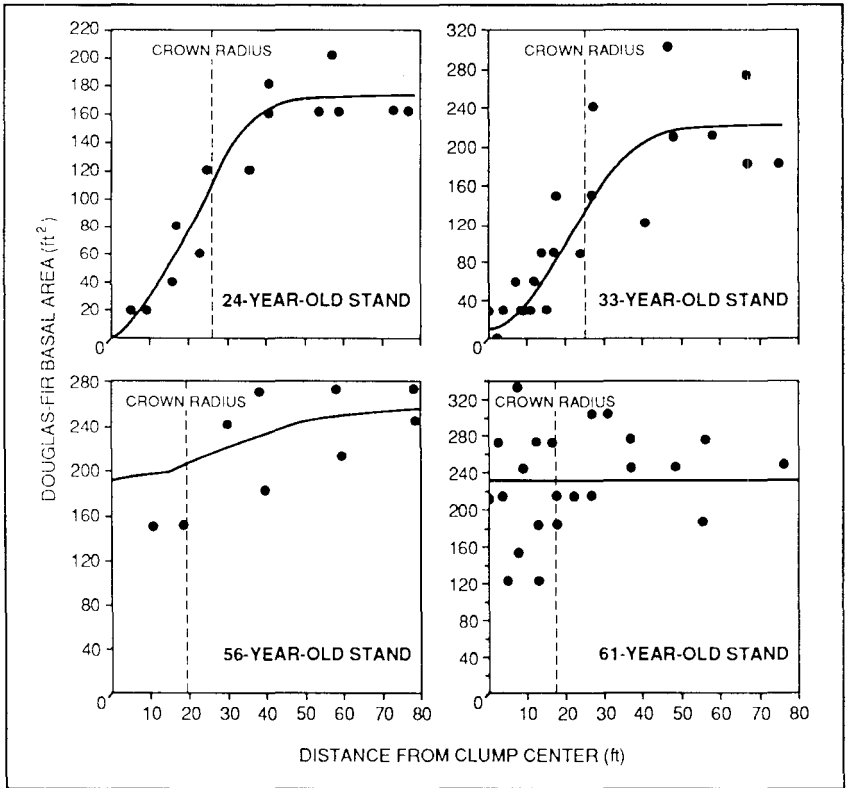


FIGURE 4. Change in Douglas-fir basal area with increasing distance from the center of individual bigleaf maple sprout clumps in stands of various ages.

however, the size of the “hole” apparently decreases, even though actual clump size has not substantially decreased. This decrease in “hole” size may be due to allocation of wood to fewer Douglas-fir trees as stands mature, natural development of similar-sized “holes” in the adjacent Douglas-fir stand, or suppression of bigleaf maple by surrounding Douglas-fir trees. Data from this Phase also are being used to develop the computer model in Phase III.

Phase III: a stand simulator for predicting Douglas-fir yield losses from bigleaf maple

Funding provided by the Washington State Department of Natural Resources this past year supported a new project, coordinated by Tim Harrington, Dan Opalach, and Bob Wagner, which will synthesize our current knowledge on bigleaf maple into an interactive computer simulator called CLUMP (Competition Losses Using Maple Projections). CLUMP is being designed to integrate the growth models developed in Phases I and II (Figure 5) with the treatment effects derived from the previously mentioned

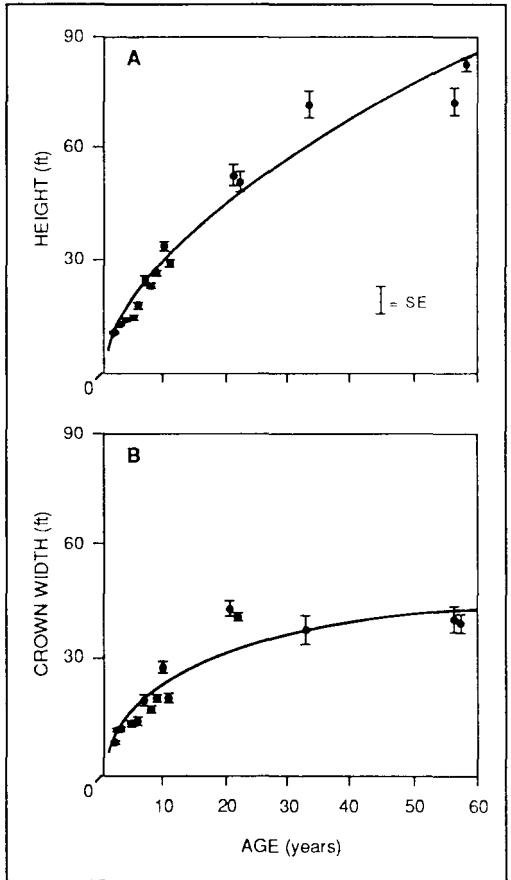


FIGURE 5. Height (A) and crown-width development (B) of bigleaf maple sprout clumps.

CRAFTS study on controlling bigleaf maple sprout clumps. The structure of the **df et al.** model also is being applied to CLUMP, making the two models fully compatible. When completed, CLUMP will use current site and stand characteristics, financial information, and treatment options to project the potential outcome of various vegetation-management alternatives in Douglas-fir stands up to 60 years old. A working version of CLUMP is expected in fall 1989.

Fundamental Studies

An important component of the CRAFTS Program is fundamental research. Generally funded from outside sources, these studies improve our understanding of the biological and ecological processes that influence forest systems. Such studies result in innovative technology and better management.

Douglas-fir/red alder replacement series

A long-term study, led by Dave Hibbs and Steve Radosevich, is investigating the effects of stand density, species proportion, and soil nitrogen on the interactions between red alder and Douglas-fir on several Oregon and Washington sites with a range of soil nitrogen levels. Other research has demonstrated that a spectrum of interactions between these species, from severe antagonism to increased productivity, is possible. The study objective is to determine where strong antagonisms or benefits can be expected in Douglas-fir/red alder mixtures, and how to manage stand density and species proportion to maximize any potential benefits.

Early results indicate that biomass allocation patterns for each species do not differ by site. Thus, size differences among sites do not appear to result from stress-induced modifications of plant form. In the one exception—biomass of nitrogen-fixing nodules of red alder on the site with high soil-nitrogen levels—nodule biomass was low for a given plant size. As a result, plants could put more energy into aboveground growth.

Autecology of salmonberry and thimbleberry

Salmonberry and thimbleberry germination and seedling survival were examined by Bruce Maxwell and Steve Radosevich on four logged and burned sites at the eastern edge, middle, and western edge of the Oregon Coast Range.

On the eastern site, less than 1% of the planted salmonberry seed germinated. No naturally occurring salmonberry seedlings were observed for the first 3 years after burning. Less than 10% of the planted thimbleberry seed germinated within the first 2 years. There was one naturally occurring thimbleberry seedling/2.3 m² of ground area the first year after burning, but none survived through the third year.

On the mid-Coast Range site, less than 5% of planted salmonberry seed germinated by the second year. There was one naturally occurring salmonberry seedling/4.4 m² of ground area over the 3-year period, but none survived for more than 1 year. Seven percent of the planted thimbleberry seed germinated the first year, and none germinated the second year. There was one naturally occurring thimbleberry seedling/6 m² of ground area.

No seed were planted on the two western sites. On the western site closer to the Coast, there were over 21 naturally occurring salmonberry seedlings/m² 1 year after burning. However, survival of salmonberry seedlings consistently declined each year on both coastal sites. Few thimbleberry seedlings or sprouts were observed on either site.

Overall, study results indicate that salmonberry and thimbleberry germination rates are low on Oregon Coast Range sites. In addition, mortality rates for seedlings that do germinate are high. Salmonberry seedling survival was higher on the western than the middle or eastern sites. Increased rates of sprouting combined with poor survival of both seeded and naturally occurring seedlings on all four sites suggest that salmonberry and thimbleberry are perpetuated primarily by vegetative reproduction rather than by seed.

Competitive interactions between Douglas-fir and red alder: root and shoot biomass responses

Douglas-fir and red alder seedlings were planted into pure stands at densities of 0, 1, 2, 4, 8, and 16 trees/m² and into mixed stands composed of all possible pairwise combinations of these densities. The resulting design created a wide array of spacings and species proportions for examining competition between these two important tree species. Third-year root biomass data were obtained from the final harvest of this experiment in 1988.

At low red-alder densities, increasing the density of Douglas-fir reduced Douglas-fir root biomass. At high red-alder densities, however, increasing the density of Douglas-fir increased root biomass per Douglas-fir seedling. Response of belowground biomass was similar to that observed for aboveground biomass.

Resource, leaf area, and physiological data suggested that increasing the density of Douglas-fir in dense red alder stands reduced soil moisture available to the alder, thus suppressing red alder leaf area and increasing light availability to the understory Douglas-fir. Results from this study are now available in a Ph.D. dissertation by Lauri Shainsky.

Photosynthesis and moisture stress of Douglas-fir and red alder

The relationship between net photosynthesis and moisture stress of red alder and Douglas-fir is being studied by Jimmy Dukes with trees from Lauri Shainsky's experiments (see prior subsection), as well as other individuals of both species grown in a companion study with different levels of light and soil moisture. The premise for this investigation was the observation, from a study by Sam Chan (CRAFTS Annual Report 1987-88), that photosynthesis in Douglas-fir declined from morning to afternoon to a much greater extent than in red alder, even though both species had similar available light and soil moisture. The objective here is to determine if different sensitivities to moisture stress are responsible for the different diurnal trends in photosynthesis.

Both species responded quite differently to increasing moisture stress. Photosynthesis in red alder at first declined less than that in Douglas-fir with increasing moisture stress, but rapidly approached zero as a specific moisture-stress threshold was reached. Photosynthesis in Douglas-fir declined in proportion to increasing moisture stress. Overall, water-use efficiency (amount of photosynthesis per amount of water transpired) was higher for Douglas-fir than red alder across all moisture-stress levels.

The results suggest that Douglas-fir survives drought conditions by using water efficiently. In contrast, red alder appears to survive (and grow more rapidly) by avoiding moisture stress through more efficient extraction of soil moisture, through a more efficient water-conducting system within the plant, or both.

TECHNOLOGY TRANSFER

Rapid communication of research results to its Cooperators and others is an important part of CRAFTS' mission. This technology transfer takes several forms.

Technical Reports to Cooperators

Two publications and 17 presentations at Technical Committee meetings provided reports to Cooperators on important areas of vegetation management during 1988-89:

Publications:

- A progress report on a growth model for young Douglas-fir stands. D. Opalach and S.R. Radosevich.
- Interspecific Competition Index Projection System (ICIPS) for young Douglas-fir stands on the Siuslaw National Forest. R.G. Wagner, D. Opalach, B.D. Maxwell, J.H. Dukes, Jr., and S.R. Radosevich.

Presentations:

- Overview of MacMillan Bloedel vegetation management research. W. Beese. May 1989.

- Human exposure to triclopyr during aerial applications. V. Carrithers. May 1989.
- Vegetation management research in British Columbia. P. Comeau. May 1989.
- State of Washington spray buffer restrictions. P. Figueroa. May 1989.
- CLUMP bigleaf maple model update. T.B. Harrington. May 1989.
- Coast Range Competition Release Study update. T.B. Harrington. May 1989.
- **df et al.** young stand model update. D. Opalach. May 1989.
- Bigleaf maple control: third-year results. R.G. Wagner. May 1989.
- Competition index study results. R.G. Wagner. May 1989.
- VEGPRO computer program update. R.G. Wagner. May 1989.
- Arsenal® herbicide update. B. Alber, D. Belz, B.R. Kelpsas, and D. Newton. October 1988.
- Bibliography on competitive effects and forage seeding of herbaceous vegetation. T.B. Harrington. October 1988.
- Study plan to determine influences of herbaceous vegetation on woody plant establishment. B.D. Maxwell. October 1988.
- Thoughts for future vegetation management research. M. Newton. October 1988.
- Young stand model update. D. Opalach. October 1988.
- Development of a computer model to synthesize current CRAFTS research on bigleaf maple. R.G. Wagner. October 1988.
- VEGPRO computer program. R.G. Wagner. October 1988.

A complete list of publications by CRAFTS personnel, as well as other presentations, is provided later in this report.

Visits with Cooperators

Direct contact with field foresters of cooperating organizations is important for technology transfer. The CRAFTS staff visited with Cooperators and made the following presentations during 1988-89:

- Interspecific competition indices for vegetation management decisions on the Siuslaw National Forest. R.G. Wagner. USDA Forest Service Region 6 Silviculture Business Meeting, Portland, Oregon. December 1988.
- CRAFTS research update. R.G. Wagner and D. Opalach. Boise Cascade Corporation and Willamette Industries, Monmouth, Oregon. November 1988.
- CRAFTS research update. S.R. Radosevich, R.G. Wagner, and D. Opalach. Weyerhaeuser Vegetation Management Effectiveness Meeting, North Bend, Washington. September 1988.
- The influence of woody and herbaceous vegetation on conifer survival and growth: what have we learned from research? R.G. Wagner. Oregon Department of Forestry Annual Reforestation Conference, Coos Bay, Oregon. July 1988.
- CRAFTS research update. S.R. Radosevich, R.G. Wagner, T.B. Harrington, and D. Opalach. Cavenham Forest Industries, Seaside, Oregon. June 1988.
- Interspecific competition indices for vegetation management decisions on the Siuslaw National Forest. R.G. Wagner. Siuslaw National Forest and Bureau of Land Management Silviculture Workshop, Depoe Bay, Oregon. May 1988.

Continuing Education

The CRAFTS staff is often involved in educating professional foresters on the latest advances in vegetation management. Two symposia were held in Corvallis this year at which CRAFTS personnel were invited to speak:

- Protecting the Health of Pacific Northwest Forests Through Integrated Pest Management: A Symposium for Forest Managers, January 17-18, 1989. Steve Radosevich moderated the vegetation management section and gave an overview of concepts and principles. In this same section, Bob Wagner and Dan Opalach spoke about information access systems and predictive models. A poster on the CRAFTS Program also was presented.

- Forest Vegetation Management Workshop, January 31-February 2, 1989. Bob Wagner gave two presentations and served as moderator for the section, "Introduction to Computer-Based Tools in Vegetation Management." Tim Harrington developed and administered an exercise to teach workshop participants how to design vegetation management prescriptions. Dan Opalach gave a presentation on the development and use of ICIPS. Workshop participants also gained some hands-on experience with the VEGPRO and ICIPS computer programs.

Related Activities

Special publications

The 1987 CRAFTS publication, *Prescribed Fire in Pacific Northwest Forests: An Annotated Bibliography*, served as a catalyst for a new book entitled *Prescribed Fire in Pacific Northwest Forests*. Edited by Jack Walstad, Steve Radosevich, and Dave Sandberg, this is one of the first COPE projects to be completed. Designed to summarize in nontechnical terms what is known about the practice of prescribed burning, this text should be valuable to decision makers ranging from resource managers to legislators. Over 25 experts have been enlisted to prepare chapters. Chapter drafts are currently being polished, with publication by OSU Press expected in early 1990.

The comprehensive volume, *A Silvicultural Approach to Animal Damage Management in Pacific Northwest Forests: An Annotated Bibliography*, contains over 600 references organized on the basis of animal species. References are indexed by subjects, which include general information on each species (from symposia, monographs, and bibliographies), ecology (activity, demography, reproduction, habitat, range, and movements), and animal damage management (damage assessment, management tools, and economics). Currently in review, the bibliography will be published through the Forest Service in summer 1989. It will serve as a source volume and supplement to a compendium, being prepared under the direction of Hugh Black, Steve Radosevich, and Jack Walstad,

on interactions between silviculture and animal damage management in the Pacific Northwest.

Review and field tour of CRAFTS fundamental studies

Specific CRAFTS fundamental studies have focused on (1) methods for examining plant interactions, (2) how acquisition and use of site resources influence such interactions, and (3) models to elucidate responses of young crop trees and stands to competition. Various national and regional USDA agencies have been instrumental in CRAFTS' ability to initiate this ambitious research program (see earlier, "Fundamental Studies," for details):

- Competitive Grants Program
- National Agricultural Pesticide Impact Assessment Program
- Pacific Northwest Research Station, Forest Service
- Pacific Southwest Forest and Range Experiment Station, Forest Service
- Regions 5 and 6, Forest Service
- Siuslaw National Forest, Forest Service
- Timber Management (Washington, D.C.), Forest Service

Representatives from the above agencies were invited to a review and field tour of our fundamental studies program last summer. On that occasion, CRAFTS personnel and graduate students demonstrated and described current research.

ORGANIZATIONAL ACTIVITIES

One strength of the CRAFTS Program is that Cooperators are directly involved in determining research directions. CRAFTS committees and subcommittees met six times during 1988-89.

Policy Committee

The Policy Committee met in June 1988 on OSU Research Cooperative Policy Day to review current research

and approve funding levels proposed for those projects. Three proposals from the Short-Term Projects Subcommittee were approved, and a Research Directions Subcommittee was formed. Tom Terry (Weyerhaeuser) served as Executive Officer for the Committee during 1988-89.

Technical Committee

The Technical Committee met in October 1988 and May 1989. At the October meeting, the Committee reviewed current projects, approved an outline for an upcoming bibliography on herbaceous vegetation, and reviewed a proposal to develop a bigleaf maple/Douglas-fir computer simulator. At the May meeting, the Committee reviewed proposals from the Research Directions Subcommittee, discussed current projects, and provided reports on vegetation-management issues on Cooperator lands.

Young Stand Model Subcommittee

A working group from the CRAFTS/COPE Young Stand Model Subcommittee met in September 1988 to review model development and provide technical guidance. This ongoing Subcommittee meets as needed to address critical issues related to the Young Stand Model. Kelsey Milner (Champion International) and Bob Wagner (CRAFTS) co-chaired this Subcommittee.

Research Directions Subcommittee

This newly formed Subcommittee to review CRAFTS research directions met in December 1988 and March 1989 to establish research priorities for the Cooperative over the next several years. At the December meeting, the purpose, scope, and objectives of CRAFTS were re-examined, current research projects evaluated, and potential areas for future research identified. CRAFTS staff then prepared four research proposals reflecting established priorities. At the March meeting, the Subcommittee reviewed and ranked each proposal to be presented to the Technical and Policy Committees for approval.

The Cooperative thanks Gary Blanchard (Starker Forests), Ron Heninger (Weyerhaeuser), Greg Johnson (International Paper), Rob Mangold (Cavenham Forest Industries), Kelsey Milner (Champion International), Ken Munson (International Paper), Tom Terry, Chair (Weyerhaeuser), Bill Voelker (Oregon Department of Forestry), and Diane White (Bureau of Land Management) for serving on this Subcommittee.

PUBLICATIONS AND PRESENTATIONS

CRAFTS personnel prepared the following publications and presentations during 1988-89:

Refereed Publications

- Newton, M., and D.S. Preest. 1988. Growth and water relations of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco). *Weed Science* 36:653-662.
- Petersen, T.D., M. Newton, and S.M. Zedaker. 1988. Influence of *Ceanothus velutinus* and associated forbs on the water stress and stemwood production of Douglas-fir. *Forest Science* 34:333-343.
- Radosevich, S.R., and M.L. Roush. 1989. The role of competition in agriculture. *In Perspectives on Competition*. J. Grace and D. Tillman, eds. Academic Press, New York (in press).
- Roush, M.L., S.R. Radosevich, R.G. Wagner, B.D. Maxwell, and T.D. Petersen. 1989. A comparison of methods for measuring effects of density and proportion in plant competition experiments. *Weed Science* 37:268-275.
- Wagner, R.G., T.D. Petersen, D.W. Ross, and S.R. Radosevich. 1989. Competition thresholds for the survival and growth of ponderosa pine seedlings associated with woody and herbaceous vegetation. *New Forests* (in press).

Progress Reports and Newsletters

- Cole, E.C., and M. Newton. 1988. Evaluation of herbicides for forest site preparation in coastal Oregon. P. 89-93 *in*

- Western Society of Weed Science, 1988 Research Progress Report.
- Cole, E.C., and M. Newton. 1988. Evaluation of herbicides for weed control in young conifer plantations in coastal Oregon. P. 86-88 *in* Western Society of Weed Science, 1988 Research Progress Report.
- Cole, E.C., and M. Newton. 1989. Using herbicides to delay vegetation development on burns. P. 122-123 *in* Western Society of Weed Science, 1989 Research Progress Report.
- Cole, E.C., M. Newton, and M. Gourley. 1989. Herbaceous weed control in young conifer plantations. P. 66-67 *in* Western Society of Weed Science, 1989 Research Progress Report.
- Cole, E.C., M. Newton, and D. Newton. 1989. Imazapyr stem injection trials. P. 145 *in* Western Society of Weed Science, 1989 Research Progress Report.
- Lanini, W.T., and S.R. Radosevich. 1988. Successional changes in conifer communities following three methods of site preparation and three levels of secondary herbicide release. P. 94-95 *in* Western Society of Weed Science, 1988 Research Progress Report.
- Newton, M., J.C. Tappeiner, and A. Ortiz-Funez. 1988. Pine and manzanita pull water out of rocks. FIR Report 10(3):4/5.
- Opalach, D., and S.R. Radosevich. 1988. Modeling the growth of Douglas-fir and competing hardwood and shrub vegetation. COPE Report 1(3):2-4.
- Opalach, D., and S.R. Radosevich. 1988. A progress report on a growth model for young Douglas-fir stands. CRAFTS Technical Report, Forest Research Laboratory, Oregon State University, Corvallis, Oregon. 22 p.
- Radosevich, S.R., R.G. Wagner, T.B. Harrington, D. Opalach, and M. Newton. 1988. CRAFTS annual report 1987-1988. Forest Research Laboratory, Oregon State University, Corvallis, Oregon. 42 p.
- Wagner, R.G. 1988. Factors influencing the delivery and effectiveness of triclopyr in the control of bigleaf maple

sprout clumps. CRAFTS Technical Report, Forest Research Laboratory, Oregon State University, Corvallis, Oregon. 13 p.

Wagner, R.G., D. Opalach, B.D. Maxwell, J.H. Dukes, Jr., and S.R. Radosevich. 1989. Interspecific competition index projection system (ICIPS) for young Douglas-fir stands on the Siuslaw National Forest: report 2, Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon. 77 p.

Proceedings and Abstracts

Cole, E.C., and M. Newton. 1988. Comparative growth responses of Douglas-fir and grand fir at varying densities. *Northwest Science Abstracts* 62(2):67.

Cole, E.C., and M. Newton. 1988. Evaluation of 2,4-D and sulfometuron for shrub and herbaceous weed control. *Weed Science Society of America Abstracts* 28:34.

Cole, E.C., and M. Newton. 1988. Potential use of fluroxypyr alone and in mixtures for pine release. *Proceedings, Western Society of Weed Science* 41:101-108.

Gourley, M., M. Vomocil, and M. Newton. 1988. Forest weeding to protect Douglas-fir from deer browsing. *Proceedings, Western Society of Weed Science* 41:108.

Harrington, T.B. 1989. An exercise for teaching preparation of vegetation management prescriptions. *In Forest Vegetation Management Workshop Notebook*. Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon.

Harrington, T.B. 1989. Knowing the weeds: bigleaf maple and vine maple. *In Forest Vegetation Management Workshop Notebook*. Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon.

Harrington, T.B., and J.C. Tappeiner. 1989. Vegetation management research in southwestern Oregon. *In Proceedings, 79th Annual Western Forestry Conference*, Seattle, Washington.

McComb, W.C., and M. Newton. 1988. Short-term response of small animals and amphibians to glyphosate application in

- a riparian zone. *In* Proceedings, Annual Meeting of the Oregon Wildlife Society, Pendleton, Oregon.
- Newton, M. 1989. Knowing the weeds: herbs and grasses. *In* Forest Vegetation Management Workshop Notebook. Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon.
- Newton, M. 1989. Strategies in site preparation and release: how. *In* Forest Vegetation Management Workshop Notebook. Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon.
- Newton, M., E.C. Cole, D.E. White, and M.L. McCormack, Jr. 1988. Long-term efficacy of herbicides for releasing spruce-fir. *Weed Science Society of America Abstracts* 28:34.
- Opalach, D. 1989. Introduction to computer based tools in vegetation management—ICIPS. *In* Forest Vegetation Management Workshop Notebook. Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon.
- Opalach, D., and S.R. Radosevich. 1989. Modeling the effects of vegetative competition on Douglas-fir growth. *In* Proceedings, 79th Annual Western Forestry Conference, Seattle, Washington.
- Opalach, D., R.G. Wagner, B.D. Maxwell, J.H. Dukes, Jr., and S.R. Radosevich. 1989. A simulation model of competing Douglas-fir and salmonberry. *In* Proceedings, IUFRO Forest Simulation Systems Conference, Berkeley, California.
- Radosevich, S.R., R.G. Wagner, and D. Opalach. 1989. Advances in forest vegetation management. *In* Proceedings, Protecting the Health of Pacific Northwest Forests Through Integrated Pest Management: A Symposium for Forest Managers. College of Forestry, Oregon State University, Corvallis, Oregon.
- Wagner, R.G. 1989. An overview of CRAFTS vegetation management research in the Pacific Northwest. *In* Proceedings, 79th Annual Western Forestry Conference, Seattle, Washington.

- Wagner, R.G. 1989. VEGPRO: forest vegetation management prescription optimization and information system. *In* Forest Vegetation Management Workshop Notebook. Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon.
- Wagner, R.G., D. Opalach, T.B. Harrington, and S.R. Radosevich. 1989. A computerized system for optimizing forest vegetation management treatment prescriptions. *Weed Science Society of America Abstracts* 29:104.
- Wagner, R.G., D. Opalach, B.D. Maxwell, J.H. Dukes, Jr., and S.R. Radosevich. 1989. Interspecific competition index projection system for young Douglas-fir stands. *Weed Science Society of America Abstracts* 29:248.
- Wagner, R.G., and S.R. Radosevich. 1988. Interspecific competition indices for vegetation management decisions in young Douglas-fir stands. *In* Vegetation Competition and Responses: Proceedings of the Third Annual British Columbia Vegetation Management Workshop. British Columbia Ministry of Forests and Lands, and University of British Columbia, Vancouver, British Columbia. FRDA Report 026.
- White, D.E., and M. Newton. 1988. Effect of whiteleaf manzanita and herbs on growth of juvenile Douglas-fir and ponderosa pine. *Weed Science Society of America Abstracts* 28:35.

Other Presentations

- Vegetation management and reforestation success.
R.G. Wagner. Forest Regeneration and Site Preparation Course, University of Idaho, Moscow, Idaho. February 1989.
- Douglas-fir growth five years after manual cutting of tanoak.
T.B. Harrington. Forest Vegetation Management Workshop, Forestry Extension, Oregon State University, Corvallis, Oregon. January 1989.
- An introduction to forest vegetation management tools and techniques. R.G. Wagner. Forest Vegetation Management

Workshop, Forestry Extension, Oregon State University, Corvallis, Oregon. January 1989.

A new computer simulator for Douglas-fir and bigleaf maple interactions in the Pacific Northwest. R.G. Wagner. Forest Vegetation Management Workshop, Forestry Extension, Oregon State University, Corvallis, Oregon. January 1989.

Recent advances in forest vegetation management.

R.G. Wagner. Advances in Reforestation Technology, Society of American Foresters, Roseburg, Oregon. November 1988.

Young stand models. D. Opalach. Northern Rocky Mountain Stand Management Council Annual Meeting, Spokane, Washington. June 1988.

Vegetation management problems and research in the Pacific Northwest. R.G. Wagner. University of Minnesota, College of Forestry, Cloquet Forestry Center, Cloquet, Minnesota. June 1988.

FINANCIAL STATEMENT: SUPPORT RECEIVED

Cooperators

Boise Cascade Corporation	\$5,500
British Columbia Ministry of Forests	5,500
Bureau of Land Management	5,500
Cavenham Forest Industries	5,500
Champion International Corporation	5,500
International Paper Company	5,500
ITT-Rayonier, Inc.	5,500
Lone Rock Timber Company	2,750
MacMillan Bloedel Limited	5,500
Oregon State Department of Forestry	5,500
Simpson Timber Company	5,500
Starker Forests, Inc.	2,750
Washington Department of Natural Resources	19,500
Weyerhaeuser Company	5,500
Willamette Industries, Inc.	<u>5,500</u>
Subtotal	\$91,000
Forest Research Laboratory, Oregon State University	111,340
Subtotal	<u>\$202,340</u>

Other Sources¹

USDA, Siuslaw National Forest ² (Radosevich and Wagner, 1988-89)	\$16,500
USDA, Forest Service NAPIAP Program (Radosevich and Hibbs, 1988-89)	36,285
USDA, Forest Service, Region 6 (Radosevich and Roush, 1989-90)	6,000
USDA, Competitive Grants: Biological Stress ² (Hibbs and Radosevich, 1986-89)	80,000
USDA, Competitive Grants: Forestry ² (Newton, Cole, and Radosevich, 1988-91)	134,000
COPE ² (Walstad and Radosevich, 1987)	27,000
COPE ² (Radosevich and Newton, 1987-88)	<u>40,000</u>
Subtotal	<u>\$339,785</u>
Total	\$542,125

¹ Project leaders in parentheses.

² Includes university overhead.

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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.

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