PROCEEDINGS OF THE

NATIONAL SILVICULTURE

WORKSHOP

FLAGSTAFF, ARIZONA

SEPTEMBER 26-30, 1977

Silvicultural Implications of Section 4, NFMA 1976

Division of Timber Management
USDA-Forest Service
Washington, D.C.

Introduction

The 1977 Silviculture Workshop was held in Flagstaff, Arizona, September 26-30, 1977. The objective of the meeting was to discuss the reforestation and maintenance of appropriate forest cover required by Section 4 of the National Forest Management Act of 1976. These proceedings include the presentations that were available for publication.

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FINAL

National Silviculture Workshop
September 26-30, 1977
Flagstaff, Arizona

AGENDA

Silvicultural Implications of Section 4, NFMA 1976

Monday, September 26

8:00 a.m.	Introductions	Robert Gillespie, WO
	Workshop Announcements	Bob Pearl, WO (General Chairman)
	Local Announcements	Darrell Crawford, R-3
8:30 a.m.	Welcome	Gary Cargill, R-3 (DRF)
8:45 a.m.	Purpose of Meeting	Robert Gillespie
9:00 a.m.	Work Group Report on Section 4, NFMA	Wayne Mann, R-9 (Chairman)
10:00 a.m.	BREAK	
10:15 a.m.	Implementing Section 4 - Modifications needed Regionally	
	R-2	Jack Bennett
	R-1	Jack Usher
	R-9	Bob Bloomquist
	R-6	Jack Todd
12:00 Noon	LUNCH	
1:15 p.m. to 4:30 p.m.	Appropriate Vegetation for the Resources	Don Strode, WO (Chairman)
	Recreation	Kent Mays, WO
	Wildlife	Ed Schneegas and Chuck Sandstrom, R-1
	Watershed	Jack Corliss, R-8
	Range	Bill Pint, R-3
	Discussion	

Tuesday, September 27

8:00 a.m.	Endangered Species	Bill Zeedyk, WL, WO
9:00 a.m.	Potential Vegetation as an Indicator of Reforestation Opportunity (habitat type)	Bob Pfister, INT
10:00 a.m.	BREAK	
10:15 a.m.	The Use of Soils Information in Evaluating Reforestation Potential	Andrew A. Leven, R-5
11:00 a.m.	Alpine Silviculture for Recreation, Wildlife, Timber, and Esthetics	Jack Bennett, R-2
12:00 Noon	LUNCH	
1:00 p.m.	Section 4(e) of NFMA The Beneficial or Adverse Effects of Pesticides	Roger Sandquist, R-4
2:00 p.m.	Shoot and Tip Moth and Other Regeneration Pests - Potential Impacts and Control Alternatives	Robert Stevens, RM
2:45 p.m.	BREAK	
3:00 p.m.	How Economic Evaluations Can be Used for all Resource Benefits	Clark Row, WO
4:00 p.m.	Slide presentation on Beaver Creek Watershed - Multiresource Planning Unit	Ross Carder, RM
4:30 p.m. to 4:45 p.m.	Instructions for field trip	

Wednesday, September 28

7:30 a.m.	(tentative departure time) Travel to Experimental Forests North and South of Flagstaff	
	Prescribed Burning	John Dietrich, RM
	Density Control	Gilbert Schubert, RM
	Cutting Methods and Regeneration	LeRoy Heidmann, RM
	Grazing	
	Water Yields	
	Wildlife	
5:00 p.m.	At Payson, Arizona	

Thursday, September 29

7:30 a.m.	(tentative departure time) Chevelon Ranger District, Apache-Sitgreaves National Forest Blue Ridge Ranger District, Coconino National Forest	
5:30 p.m.	Return to Flagstaff, Arizona	

Friday, September 30

8:00 a.m.	K-V Act Modification and Implementation	Robert Gillespie
8:30 a.m.	Chief's Study Team Report on Reforestation and TSI	Jim Sabin and LaMont Engle, WO
9:30 a.m.	Nursery Needs for Section 4	Tom Greathouse, WO
10:00 a.m.	Research Needs A Program for Vegetation Management Including Plant Associations Fertilizer Control Methods Protection - Animals and Insects	Carl Bernsten, WO
10:30 a.m.	Open Topics	Bob Pearl
11:30 a.m.	Wrap Up	Robert Gillespie
12:00 Noon	Workshop Adjourn	

Silvicultural Workshop
Flagstaff, Arizona
September 26, 1977

NAME	REPRESENTING	FIELD TRIP YES	FIELD TRIP NO	ROOM NUMBER
LaMont Engle	WO - Timber	x		132
David L. Johnson	R-10 - Timber	x		285
Chuck Sandstion	R-1 - Beaverhead		x	167
James Sabin	R-8	x		256
Don Strode	WO - WL	x		174
Darold D. Foxworthy	WO - F&AM	x		275
Charles Bechtel	R-3 - Kaibab NF	x		
Jerry Hustead	R-3 - Apache-Sitgreaves	x		153
Harold Flake	S-PF South East	x	first day only	240
Robert Gillespie	WO - Timber	x		203
Bill Tuttle	R-9	x		163
Andy Leven	R-5 - Watershed	x		202
Robert E. Dawnan	R-2 - Bighorn NF	x		265
Robert W. Pearl	WO - Silviculture	x		249
Bill Zeedyk	WO - Wildlife	x		234
Orville Engelby	R-4 - Silviculture	x		207
John Robateels	R-4 - Ashley NF	x		299
Douglas Eggens	R-4 - Bridger-Teton NF	x		273
Tom Greathouse	WO - Timber	x		253
John Tappeiner	R-5 - Silviculture	x		206
William R. Beaufait	R-1 - Silviculture	x		266
Frank Ronco	Rocky Mountain Station	x		
Gilbert Schuburt	Rocky Mountain Station	x		
Jack Todd	R-6 - Timber	x		168
Jerry Edwards	San Dimas - EDC	x		103
Michael Kerrick	R-3 - Coconino NF		x	
Ray Dougherty	R-5 - Timber	x		208
Bob Mathison	R-2 - Timber	x		294
Bob Jackson	R-2 - Timber	x		283
Earle Darby	R-8 - Timber	x		130
Wes Bates	R-3 - Timber	x		156
Jerry Goon	R-3 - Timber		x	
Bill Chapparo	R-3 - Timber	x		156
Ed Schneegas	R-1 - WL		x	194
Roger Sandquist	S&PF	x		193
Walter Fox	R-8	x		274
Kent Mays	WO -		x	141
Wayne Mann	R-9 Chequamegon	x		292
Jack H. Usher	R-1 - Timber	x		164
Ralph Kizer	R-1	x		290
Lee Northcutt	MEDC	x		217
Bob Stevens	Rocky Mountain Station		x	199
Magus E. Chelstad	WO- Timber	x		201
Gary Cargill	RO - Deputy Regional Forester		x	
Bob Pfister	INT - Missoula	x		297
Will Charter	R-5 - Timber	x		207
Carl Puuri	R-6 - Timber	x		298
Robert Blomquist	R-9	x		269
John Hughes	R-6 - Timber	x		279
Clark Row	WO	?		291
John F. Corliss	R-8 WS&M	x		271
Jack Bennett	R-2 - Timber	x		267
Jack Utley	R-3 - Coconino NF			
Darrell Crawford	R-3 - RO Timber			

Presented by Gary Cargill

Silviculture Workshop

We welcome you to the Southwestern Region for your Silviculture Workshop. This is the first such workshop in the Region. It is a pleasure to have all this expertise visit us and take a look at our silvicultural practices.

The program for this workshop emphasizes Section 4, Reforestation of the National Forest Management Act of 1976. The principle charge in this section is, "It is the policy of the Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans."

This is a tremendous task and challenge. Here in the Southwest, where we have high fire occurrence, our reforestation backlog alone seems almost impossible to accomplish, particularly by the 1985 date established by Congress. I know that all of you face similar situations and it is going to take research, and application of latest technical knowledge to accomplish our goals. The NFMA was a vote of confidence in professional forestry---in you---who else is better able to do the job.

Flagstaff is a very appropriate location by the silviculture workshop. It was here, sixty-nine years ago, August 1908, that Raphael Zon, Chief of Silviculture in the Forest Service, selected Fort Valley as the first forest experiment station in the United States. This was the start of research in forest management and silviculture as we know it today.

The first research scientist at Fort Valley was G. A. "Gus" Pearson, who from 1908 until his death in 1949 conducted silvicultural investigations for his now famous monograph, "Management of Ponderosa Pine in the Southwest." The lack of advance reproduction in 1908 was the main reason for beginning research at Fort Valley and Gus Pearson spent most of his career researching the regeneration problem. An impressive roster of foresters have worked at Fort Valley over the years and it is interesting to note in their publication---"Half a Century of Research---1908-1958"---their requirements for successful artificial regeneration:

1. Use only local seed, or first-grade seedlings grown from local seed.

2. Plant only on sites where Ponderosa Pine has grown in the past.

3. Avoid areas of heavy competition from grass or weeds, or control the competition.

4. Protect seed from rodents and birds, and seedlings from animals.

It has been nearly 20 years since this advice was published and we still have difficulty with these basics.

Thursday you will be visiting my old Ranger District---the Blue Ridge District---and you will see some of the finest stands of Ponderosa Pine in the Southwest. These stands have gone from a virgin state, of not too many years ago, to a managed condition. They have received two sawtimber harvests, a pulpwood harvest and a precommercial thinning under a multiple use concept. Indications are that under these managed conditions we have doubled the growth rate. I think you will find the results of these intensive practices very interesting.

It has not been my intention to tell you what you are going to hear and see this week, but to welcome you to the Southwest. This I do with great enthusiasm and hope that you all experience a profitable, enjoyable workshop. I would also like to challenge you to find silviculturally sound ways to manage all species and stands in an environmentally acceptable manner. The "know-how" is here in this room.

Presented by Robert Gillespie

Purpose of 1977 Silviculture Workshop

Welcome to our annual Silviculture workshop. As you have noted, the theme is "Silvicultural Implications of Section 4, Reforestation, NFMA 1976."

You probably have all heard or read the charge by the Congress given the Forest Service. I am certain you will hear it several more times this week, but I don't believe repetition is bad in this instance. The Congress stated, "It is the policy of the Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans."

Some of you may react, "So what---we have heard that before." or "We have been doing that all along." or "That's been policy for years." or "Management of timber still dominates the Forest Service."

There are two real changes however. One, it is now more than a policy of the Forest Service, it is law. And secondly, the Congress has authorized funding of silvicultural practices for other than for increased commercial timber production. We can now more easily justify using silvicultural appropriations for other resources having little or

no impact on increased commercial timber production. The Act is no panacea that guarantees we are now able to do all the things we would like and need to do. These additional projects are a part of our normal program, planning and budgeting system. Districts, National Forests, Regions, and the Chief will continue to establish priorities. There will remain the constraint of the overall Forest Service budgeting limitations. However, we want to emphasize, there are now opportunities to use proper silviculture practices to benefit all resource management rather than just timber production.

I should mention at this time that the Act authorizes to be appropriated up to $200,000,000 annually to implement this portion of the NFM Act. However, an authorization is just that. It is not an assured appropriation. The Forest Service must still follow the normal appropriation process to obtain these funds.

The Interior and Related Agencies Appropriation Committee has already looked favorably upon the Act. The Committee raised the appropriation for silvicultural activities for F.Y. 1978 $7.8 million above the budget submission. The total appropriation for F.Y. 1978 is at the $72 million level compared to the $15.8 million level 10 years ago when I came to Washington. Another good feature of the Act is that it authorizes that appropriated funds may be available until expended. This is not automatic. The F.Y. 1978 appropriation provides for expending the funds by September 30, 1979,

a two-year period. We are all going to have to watch for abuses of the carryover provision. We do not want to encourage carryovers of unused funds at the district, forest, regional, or national level.

Back to the theme of the workshop. Your next speaker, Wayne Mann, is Chairman of a work group assembled by the Chief to recommend proposed policy, direction, and implementing instructions necessitated by Section 4. I won't steal any of his thunder but I do want you to note we have been working on implementing Section 4 of the Act for some time.

As you read your program, you will observe that Bob Pearl has assembled an excellent group of speakers to discuss all phases of reforestation and timber stand improvement and their relationship to all resource management.

The field portion of the workshop promises to be instructive also. We want to thank the Rocky Mountain Station staff for what we are certain will be an interesting trip. Likewise, we want to thank the Regional staff, the participants from the Apache-Sitgreaves Forest and the Coconino Forest for their portion of the field trip.

Lastly, we charge all attending to take home what you have learned and share your gained knowledge. Too often the process stops with those attending the workshop. Let's not do that this year. Let's all spread the knowledge at our home units.

This is your workshop. Let's make it a productive and stimulating session.

Presented by Wayne Mann

PRESENTATION - SILVICULTURE WORKSHOP
September 26-30, 1977

WORK GROUP REPORT ON SECTION 4, NFMA, 1976

IN MAY, AFTER SOME PRELIMINARY DISCUSSIONS WITH BOB GILLESPIE, I WAS ASKED TO CHAIR A WORK GROUP ON SECTION 4 OF THE NATIONAL FOREST MANAGEMENT ACT. MEMBERS OF THE MULTI-DISCIPLINARY WORK GROUP WERE: PETE LAIRD, R-1, REGENERATION AND PLANNING; TONY AROGON, R-3, FISCAL MANAGEMENT; JACK ADAMS, R-3, WILDLIFE MANGEMENT; ORVILLE ENGELBY, R-4, SILVICULTURE; JOHN UNDERWOOD, R-5, TM STAFF, SIERRA NATIONAL FOREST; DICK SHAFFER, R-6, TM STAFF, OLYMPIA NATIONAL FOREST; DOYLE TURMAN, W.O., MENSURATIONIST, FT. COLLINS, COLORADO.

IN DISCUSSIONS WITH BOB GILLESPIE, BOB PEARL, DICK WORTHINGTON, AND OTHER W.O. STAFF, WE ESTABLISHED A TARGET DATE OF AUGUST 1ST. WE WERE ALL AWARE THAT THIS EARLY DATE WOULD PRESENT SOME DIFFICULTIES. HOWEVER, IN LOOKING AT THE CRITICAL NEED TO ESTABLISH A NATIONAL REPORTING SYSTEM AS REQUIRED BY CONGRESS FOR REFORESTATION AND TSI, WE ALSO WANTED TO TIE OUR WORK IN WITH THE CHIEF'S STUDY OF REFORESTATION AND TSI PROGRAMS. IN ADDITION, THE W.O. STAFF FELT STRONGLY THAT TIMBER MANAGEMENT HAD A MAJOR RESPONSIBILITY TO TAKE THE LEAD IN PROVIDING RECOMMENDATIONS TO THE SECTION 6 TEAM REGARDING TIMBER MANAGEMENT ACTIVITIES. IN THE SHORT TIMESPAN ALLOWED, I PLANNED THREE GROUP MEETINGS WITH TEAM MEMBERS WORKING INDIVIDUALLY, OR IN SMALL GROUPS ON SPECIFIC ASSIGNED ITEMS BETWEEN THE GROUP MEETINGS. WE MET AS A TEAM THREE TIMES FOR A WEEK PERIOD. PARTICIPATION AND INVOLVEMENT OF OTHER INTERESTED STAFF AT THE WO, RO, AND FOREST LEVELS WAS ALSO ENCOURAGED. AN INFORMAL TIE WAS ESTABLISHED WITH THE MEMBERS OF THE CHIEF'S REFORESTATION AND TSI WORK GROUP.

OUR BASIC CHARGES UNDER A CHARTER PREPARED BY BOB GILLESPIE AND THE OTHER W.O. STAFF WERE:

---DEFINE "LEGAL BASIS" FOR NEED TO ESTABLISH POLICY FOR IDENTIFICATION, CONTROL, AND REPORTING OF "BACKLOG" AND CURRENT REFORESTATION AND TSI NEEDS.

---RESEARCH AND ESTABLISH "CONGRESSIONAL INTENT" REGARDING REFORESTATION AND TSI FOR ALL RESOURCE PURPOSES ON PRODUCTIVE, UNPRODUCTIVE FOREST LANDS, AND LANDS IDENTIFIED AS PRODUCTIVE FOR TIMBER PRODUCTION BUT UNSUITABLE FOR SUCH.

---PREPARE BROAD POLICY STATEMENT FOR CHIEF REGARDING:

--LANDS TO BE KEPT IN APPROPRIATE FOREST COVER ON PRODUCTIVE FOREST LANDS.

--LANDS TO BE TREATED FOR RATE OF GROWTH AND TO IMPROVE CONDITIONS OF THE STANDS FOR TIMBER AND OTHER RESOURCE PURPOSES ON PRODUCTIVE FOREST LANDS.

--TREATMENT OF PRODUCTIVE FOREST LANDS UNSUITABLE FOR TIMBER PRODUCTION.

--IDENTIFICATION AND TREATMENT OF LANDS UNPRODUCTIVE FOR TIMBER BUT SUITABLE FOR OTHER RESOURCE OR USE PURPOSES.

---ESTABLISH REFORESTATION AND TSI PRIORITIES FOR PRODUCTIVE AND UNPRODUCTIVE TIMBER LANDS WHICH MAY BE SUITABLE FOR OTHER MULTIPLE-USE BENEFITS.

---PREPARE MANUAL SUPPLEMENTS TO:

--DESCRIBE AND DEFINE SILVICULTURE NEEDS TO BE REPORTED ANNUALLY.

--SET STANDARDS BY WHICH REFORESTATION AND TSI NEEDS FOR MULTIPLE-USE OUTPUT PURPOSES WILL BE DETERMINED.

--DEFINE HOW BACKLOG AND CURRENT REFORESTATION AND TSI DATA WILL BE REPORTED TO THE CHIEF.

--SET REQUIREMENTS FOR 1- AND 3-YEAR INSPECTIONS OF WORK.

--SET CERTIFICATION STANDARDS FOR TIMBER AND OTHER MULTIPLE-USE REFORESTATION AND TSI WORK.

--ELIMINATE BACKLOG BY 1984.

--KEEP ABREAST OF CURRENT NEEDS.

--REQUIRE ANNUAL SUBMISSION OF FUND NEEDS FOR TIMBER AND OTHER MULTIPLE-USE BENEFITS.

--IDENTIFY HOW TO HANDLE WHERE BACKLOG CANNOT BE TREATED IN 8 YEARS.

--DEVELOP ACCOUNTING PROCEDURES FOR FY78 FOR CARRYOVER DOLLARS, GA ASSESSMENTS FOR CARRYOVER, RESPONSIBILITY FOR PROPER FUND EXPENDITURE.

THE REFERENCE MATERIAL WE USED IS TOO VOLUMINOUS TO LIST IN ITS ENTIRETY. HOWEVER, SOME PRINCIPAL DOCUMENTS USED WERE:

--NFMA, 1976

--RESEARCH ITEMS ON PRIORITY ESTABLISHMENT, COST/BENEFIT, IRR AND COST EFFECTIVENESS.

--SAF TERMINOLOGY AND WILDLAND PLANNING GLOSSARY.

--BUSINESS MEETINGS ON NFMA, 1976; COMMITTEE ON AGRICULTURE, U.S. HOUSE.

--LEGISLATIVE HISTORY OF NFMA, 1976.

--CHIEF'S STUDY OF REFORESTATION AND TSI PROGRAMS.

--ALL MATERIAL RELATED TO 2490 ON NATIONAL SILVICULTURAL REPORTS.

--FOREST SERVICE DIRECTIVE SYSTEM.

THE FOLLOWING WORK GROUP REPORT AND RECOMMENDATIONS WERE SUBMITTED TO THE CHIEF THE FIRST WEEK IN AUGUST:

IV. THE TEAM PREPARED THE FOLLOWING:

1. DRAFT FSM SUPPLEMENT, REFORESTATION

2. DRAFT FSM SUPPLEMENT, TIMBER STAND IMPROVEMENT
3. SUPPORTING DOCUMENTATION THAT REFORESTATION AND TSI ON FORESTED LANDS WILL BE CARRIED OUT FOR OTHER MU-SY BENEFITS.
4. PRIORITY ESTABLISHMENT DISCUSSION, ALTERNATIVES AND RECOMMENDATIONS.
5. NFMA DEFINITIONS.
6. RECOMMENDED CHANGES TO FSM 2410-2418.
7. RECOMMENDED FSM SUPPLEMENT, SILVICULTURAL EXAMINATIONS AND PRESCRIPTIONS, FSM 2478.
8. DRAFT FSM SUPPLEMENT FOR 2490, RECORDS AND REPORTS.
9. DRAFT FSM SUPPLEMENT FOR SILVICULTURAL PRACTICES, 2496.
10. FINANCE AND ACCOUNTING DRAFT FSM SUPPLEMENTS, 6553.12b and 6556.
11. ALTERNATIVE EVALUATION OF FINANCIAL MANAGEMENT OF CARRYOVER FUNDS IN REFORESTATION AND TSI.

IN REVIEWING THE NFMA LAW, BACKGROUND MATERIAL, OTHER LAWS, AND THE CONGRESSIONAL RECORD, THE INTENT OF CONGRESS LEAVES LITTLE DOUBT THAT REFORESTATION AND TSI WILL BE CARRIED OUT FOR ALL MULTIPLE RESOURCE USE OBJECTIVES, AND THAT ALL PROPOSED MANAGEMENT SHOULD CONSIDER BOTH TANGIBLE AND INTANGIBLE BENEFITS. IT APPEARS THAT CONGRESS INTENDS THAT WE USE BOTH TANGIBLE AND INTANGIBLE VALUES IN CONSIDERING MANAGEMENT ALTERNATIVES. THIS MEANS THAT TANGIBLE AND INTANGIBLE VALUES MUST BE GATHERED FOR ONE AREA AND COMPARED WITH APPROPRIATE VALUES FROM OTHER AREAS IN ARRIVING AT PRIORITY DECISIONS. CONGRESS WAS VERY CAREFUL TO LEAVE THE MEANS AND METHOD OF HOW THIS IS TO BE DONE TO US. DIRECTION CONCERNING PRIORITY ESTABLISHMENT PRESENTED OUR TEAM WITH THE GREATEST CHALLENGE BECAUSE OF TIME RESTRAINTS AND LACK OF SPECIALIZED KNOWLEDGE IN THE FIELD. THE SECTION 6 TEAM MUST MORE ADEQUATELY DEAL WITH THIS FORMIDABLE PROBLEM. OUR WORK GROUP RECOMMENDS THAT EACH REGION ESTABLISH ANALYTICAL TECHNIQUES WHICH BEST

MEETS THEIR SPECIFIC NEEDS IN PRIORITY ESTABLISHMENT. WE HAVE ALSO RECOMMENDED DIRECTION ON THE NEED TO UTILIZE ANALYTICAL TECHNIQUES WHEREVER POSSIBLE IN DETERMINING INVESTMENTS WHICH SHARE THE GREATEST MULTIPLE USE BENEFIT RETURNS. IN ADDITION, WE RECOMMEND THE REGIONS DEVELOP GUIDELINES FOR ASSESSING INTANGIBLE BENEFITS AND THAT THOSE AREAS ON WHICH THE MOST FAVORABLE M.U. RETURNS ARE EXPECTED WILL BE GIVEN FIRST PRIORITY FOR APPROPRIATED FUNDS. SOME REGIONS ARE ALREADY UTILIZING SUCH ANALYTICAL TECHNIQUES AND OTHERS ARE IN THE PROCESS OF INITIATING SUCH A PROGRAM TO ANALYZE BY 1980 PROGRAM BUDGET. HOWEVER, WE DID EXPRESS CONCERN THAT MANY OF THESE ANALYTICAL SYSTEMS ARE NOT DEVELOPED TO THE DEGREE THAT ALL RESOURCES AND ACTIVITIES COULD BE THOROUGHLY EVALUATED. THIS COULD LEAD TO BEING MESMERIZED BY TIMBER COST/BENEFITS AND RETURNS AT THE EXPENSE TO OTHER M.U. BENEFITS AND RETURNS. NO DOUBT, WE'LL ALL HEAR MORE ABOUT THIS COMPLEX ITEM AS THE FY 1980 PROGRAM BUDGET, THE RPA ASSESSMENT AND THE SECTION 6 TEAM REQUIREMENTS ARE WORKED ON.

ANOTHER AREA OF GREAT CONCERN TO MOST REGIONS INVOLVED THE REQUIREMENT THAT AREAS RECEIVING REGNERATION CUTS BE RESTOCKED WITHIN FIVE YEARS. THE LAW AND THE CONGRESSIONAL INTENT REGARDING THIS REQUIREMENT IS VERY SPECIFIC. OUR GROUP RESEARCHED THIS AREA VERY CAREFULLY. THERE MUST BE ADEQUATE ASSURANCE THAT ANY AREA RECEIVING A REGENERATION CUT WILL BE REGENERATED TO ADEQUATE STOCKING WITHIN FIVE YEARS. IF THIS CANNOT BE DONE, AREAS ARE NOT TO BE CUT. REGIONS RAISED QUESTIONS REGARDING WHEN THIS FIVE YEAR PERIOD WOULD BEGIN FOR SHELTERWOOD CUTS. OUR WORK GROUP RECOMMENDED THAT THE REGENERATION PERIOD SHALL BEGIN WITH THE SEED CUT.

MANY OF US APPEAR TO BE VERY ASSURED AND AT EASE WITH OUR MANY TECHNICAL DEFINITIONS. HOWEVER, OUR GROUP FOUND THAT THERE ARE MANY VARIATIONS IN DEFINITIONS AND ITS DIFFICULT TO DEFINE CERTAIN TERMS IN A CLEAR, CONCISE MANNER, SATISFACTORILY TO ALL PEOPLE. BASED ON THE NFMA LANGUAGE, WHAT DID CONGRESS MEAN

WHEN THEY TALKED ABOUT FOREST LAND, TREES, DEGREE OF STOCKING, RATE OF GROWTH, APPROPRIATE FOREST COVER, ETC.? OUR WORK GROUP ENDEAVORED TO DEFINE THESE AND OTHER TERMS WE FELT WERE NECESSARY TO ADEQUATELY RECOMMEND THE FUTURE CHIEF'S DIRECTION. ONLY TIME WILL TELL IF OUR DEFINITIONS ARE ACCEPTABLE AS THE SECTION 6 TEAM GOES ABOUT ITS JOB.

SOME OF OUR PRINCIPLE RECOMMENDED POLICIES AND DIRECTIONS ARE:

REFORESTATION

---UNITS WILL CONTINUE TO BE MANAGED UNDER EXISTING LAND AND RESOURCE PLANS UNTIL SUCH TIME AS THESE LAND UNITS ARE MANAGED UNDER PLANS DEVELOPED IN ACCORDANCE WITH NFMA.

---DEFINED BACKLOG AND CURRENT NEEDS AND HOW THEY WOULD BE HANDLED.

---DEFINED THE CRITERIA AND HAVE BACKLOG AREAS THAT WOULD NOT BE ACCOMPLISHED BY 1984, COULD BE REMOVED FROM THE BACKLOG ACREAGE.

---DEFINED TIME AND FREQUENCY OF REGENERATION EXAMINATIONS.

---DEFINED HOW FIVE YEAR LEGAL REQUIREMENTS ARE TO BE APPLIED REGARDING REGENERATION CUTS.

---DEFINED PRIORITY SETTING.

---DEFINED HOW REFORESTATION FOR OTHER PURPOSES WILL BE IDENTIFIED AND PROGRAMS AND WHAT FUNDS WILL BE USED.

---ISSUED INSTRUCTIONS FOR REPORTING BACKLOG AND CURRENT MAINTENANCE NEEDS.

---DEFINED REQUIREMENTS REGARDING PESTICIDES USE.

---HOW TO HANDLE CARRYOVER FUNDS.

---REGIONAL FORESTERS WILL ISSUE GENERAL GUIDELINES FOR REFORESTATION PRIORITIES. FOREST SUPERVISORS WILL ISSUE SPECIFIC GUIDELINES BASED ON TIMBER TYPES, STANI CONDITION CLASS AND PRODUCTIVITY CLASS.

TIMBER STAND IMPROVEMENT

---MANAGE UNITS UNDER PRESENT PLANS UNTIL PLANS ARE COMPLETED ACCORDING TO NFMA.

---TSI TO BE CARRIED OUT ON ALL FORESTED LANDS TO IMPROVE M.U. VALUES.

---TREATMENT WILL BE BASED ON MULTI-RESOURCE NEEDS AND PRIORITIES.

---TREAT STANDS WHICH WILL YIELD HIGHEST M.U. RETURNS WITH APPROPRIATED FUNDS.

2490 RECORDS AND REPORTS

---RECORD KEEPING AND REPORTING WILL BE MANAGED WITHIN THE F.S. OBJECTIVES ESTABLISHED IN FSM 1390.

---RESOURCE INFORMATION REPORTING MAY BE THROUGH CONTINUAL METHODS OR AUTOMATED DATA PROCESSING PROCEDURES.

2496 SILVICULTURAL PRACTICES

---SPECIFY REPORTING REQUIREMENTS TO MEET NFMA. REPORTS WOULD:

--IDENTIFY AMOUNT AND LOCATION BY FOREST, STATE AND PRODUCTIVITY CLASS WHERE REFORESTATION IS NEEDED.

--IDENTIFY LANDS AS ABOVE THAT ARE NOT GROWING AT THEIR BEST POTENTIAL RATE OF GROWTH.

--IDENTIFY AREAS TREATED AND HAVE BEEN CERTIFIED AS HAVING ACHIEVED A SATISFACTORY RATE OF GROWTH AND RATE OF STOCKING.

--FUNDS NEEDED TO COMPLETE BACKLOG REFORESTATION BY 1984.

--FUNDS NECESSARY TO KEEP REFORESTATION CURRENT AS LANDS BECOME DEFORESTED.

--SPECIFIES ANNUAL REPORTS TO BE SUBMITTED BY REGIONAL FORESTERS.

--SPECIFIES HOW ACCOMPLISHMENTS WILL BE REPORTED AND MAINTAINED IN THE TM-SILVA DATA BASE FILE.

THE WORK GROUP MAKES SUGGESTIONS AND RECOMMENDATIONS CONCERNING THE 2410-2418 SECTION OF THE MANUAL. SOME SPECIFIC RECOMMENDATIONS WERE:

---CHANGE WORKING CIRCLE TO NATIONAL FOREST.

---LAND CLASSIFICATION SECTION SHOULD BE REWRITTEN TO BRING IN LINE WITH TERMINOLOGY USED IN SECTION 6, NFMA.

---2416 PRESCRIPTIONS - CHANGE TITLE TO DIAGNOSIS OF TREATMENT NEEDS.

IN ADDITION, THE WORK GROUP ALSO OFFERED RECOMMENDATIONS CONCERNING 2478, SILVICULTURAL EXAMINATIONS AND PRESCRIPTIONS. OUR RECOMMENDATIONS ENDEAVORED TO BETTER DEFINE STAND EXAMINATION, STAND PRESCRIPTIONS, SILVICULTURAL EXAMINATIONS.

I BELIEVE THE WORK GROUP HAS PUT TOGETHER A PACKAGE WHICH CAN BE USED AS A FIRM BASIS FOR ESTABLISHING PROGRAM DIRECTIONS TO MEET THE NFMA LEGISLATION REGARDING REFORESTATION AND TSI. HOWEVER, THERE IS NO "TOOTH FAIRY" AS ILLUSTRATED BY HENRY VAUX'S SAF STATEMENT ON IMPLEMENTING THE RESOURCE PLANNING ACT. MR. VAUX SAID, "IMPROVE ANALYSES AND RESEARCH BASE. BOTH THE RESEARCH BASE AND THE ANALYTICAL METHODS USED IN FUTURE ASSESSMENTS AND PROGRAMS MUST BE STRENGTHENED.

IMPROVEMENTS IN THE TECHNIQUES OF ANALYSIS AND PROGRAMMING ARE CLEARLY NEEDED. SAF SPECIFICALLY RECOMMENDS THAT THE CONGRESS, IN AN AMENDED POLICY STATEMENT OR RESOLUTION, ADDRESS THE FOLLOWING DEFECTS:

---INADEQUATE RATIONALES FOR DEFINING GOALS AND PROGRAMS;

---INSUFFICIENT RANGE OF SOCIAL ALTERNATIVES EMBRACED BY PROGRAM GOALS;

---INADEQUATE EXPLANATION OF THE PROCESS BY WHICH EIGHT PROGRAMS WERE CHOSEN FROM 5,000 POSSIBLE COMBINATIONS;

---LACK OF AN EXPLICIT ANALYTICAL PROCEDURE FOR DEFINING GOALS ON A SOUND BENEFIT-COST BASIS;

---INCONSISTENT EVALUATIONS OF ANTICIPATED DEMANDS FOR THE DIFFERENT RENEWABLE RESOURCES;

---ABSENCE OF ANY ANALYSIS OF HOW THE BENEFITS AND COSTS OF THE PROGRAM WILL AFFECT VARIOUS SOCIO-ECONOMIC GROUPS;

---FAILURE TO IDENTIFY CENTRAL POLICY ISSUES WHICH ARE LIKELY TO BECOME CRITICAL IN THE FUTURE."

WE MUST ALL USE OUR BEST PROFESSIONAL KNOWLEDGE AND ABILITIES IN ESTABLISHING POLICY THAT REFLECTS THE CONGRESSIONAL MANDATE IN THE NFMA AND RPA ACT. IF WE DON'T, CONGRESS WILL BECOME MORE INVOLVED IN THE ADMINISTRATIVE ASPECTS OF THE FOREST SERVICE.

IMPLEMENTING SECTION 4 - MODIFICATIONS NEEDED REGIONALLY

Bob Blomquist
Region 9

Wayne Mann's work group had a big job assigned to them to interpret Section 4 of the NFMA and to draft appropriate manual language. They have done a commendable job.

I assume there will now follow a definite sequence of events which, hopefully, will include an opportunity for Regional review - similar to the way K-V was handled. This will be the first opportunity for Regions to seriously get at the job of Regional modifications. Before we can modify we must have something to modify. This then becomes the first Regional task in this modification process: Review of FSM draft. What we may assume now to be a need for Regional modification may in fact be covered in the final edition of the parent FSM text.

In preparing for my assignment on this program, the only basis I had for determining needs for Regional modifications was the draft material from Wayne's work group. I approached it on the basis that this was, in fact, the final edition and that their study and interpretations of the Act were faultless. In so doing, I could then resist the temptation of making a "fine-toothcomb" review of their draft and concentrate on the tasks they indicated needed doing and assess them from the standpoint of the need for Regional modifications.

As you might expect, the work group draft includes many of the tasks that are in the present edition of the manual, along with some new ones generated by Section 4 of the NFM Act. As a starting point, let's look at the list in total where it is clearly stated or implied that Regional direction is necessary.

Presented at Silviculture Workshop, Flagstaff, Arizona, September 1977.

Working through the 2472 and 2476 Sections of the manual, I'd like to present an accumulation of the most succinct statements, disregarding whether or not they are existing or new requirements. There will also be some repetition.

1. As stated in the National Forest Management Act, all forested lands in the National Forest System shall be maintained in an appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure maximum benefits of multiple-use sustained yield management.

2. Regeneration examinations will be made, as a minimum, following the first and third growing seasons after reforestation treatment. After the third year examination, the area will be certified as meeting minimum reforestation standards established by the Regional Forester.

3. The Regional Forester will develop guidelines for assessing intangible benefits.

4. Reforestation primarily for purposes other than timber production will be financed from the same appropriated reforestation funds as timber reforestation needs and activities will be identified under appropriate systems.

5. Regional Foresters will comply with FSM 2496 instructions for reporting reforestation backlog and current maintenance acreage treatment needs, schedules for completion of treatments, and funding requests to implement these treatments.

6. Reforestation monies not expended during the fiscal year in which they were appropriated may be carried over to the following fiscal year providing identified targets are attached to the funds.

7. Appropriate multiple-use considerations shall be recognized as benefits as well as the value and usefulness of the timber produced.

8. Regional Foresters will issue guidelines establishing general reforestation priorities within the Region.

9. Forest Supervisors will issue specific guidelines establishing reforestation priorities by timber types, stand condition classes, and site productivity classes.

10. Comparisons of natural regeneration with alternative reforestation methods should include consideration of the costs and benefits of each alternative including logging methods, control of species composition, stocking delays and potential yields, site preparation, release, protection, and other forest values.

11. Regional Foresters will develop procedures to correlate origin of seed and planting stock (FSM 2474.2) with areas on which it is planted and to use only seed and planting stock of known source and acceptance quality.

12. Regional Foresters should establish standard specifications as to size, age, and quality of planting stock for each tree species and for the major classes of site conditions.

13. Regional Foresters should establish guidelines by species, site-productivity class, and geographic area, covering the number of spacing of seedlings to be planted...the guidelines should contemplate full utilization of the site, within multiple-use objectives to grow all the products for which a market can be reasonably expected.

14. As required by the Forest Management Act, examinations must be scheduled after the first and third growing seasons following artificial or natural efforts to regenerate an area.

15. Satisfactory stocking will be defined to mean that an area contains a minimum number of well distributed trees per acre appropriate for various resource needs as established by the Regional Forester. Details of these minimum requirements will be provided by the Regional Forester.

16. Following the third growing season regeneration examination areas will be certified as meeting the established minimum stocking levels.

17. The standards and methods to be used for regeneration surveys shall be established by the Regional Forester.

18. Documentation of each exam will be maintained in the stand records as specified by the Regional Forester.

19. Regional Foresters will specify safety procedures for handling and storing poisons and repellents, in whatever form they are used, and for disposing of surplus and contaminated materials.

20. Design silvicultural treatments to insure that all forested land is maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth and conditions of stand designed to secure the maximum benefit of Multiple-Use Management.

21. Requests for TSI funds will be made within appropriate systems (WL, Recreation, Range, Watershed) depending on the predominate objective of the TSI.

22. Regional Foresters will comply with FSM 2496 in reporting TSI needs and schedules for completion of treatments and requests for money needed to implement these treatments.

23. The Regional Forester is responsible for certifying that TSI has been accomplished according to approved plans and prescription. The Regional Forester has at his discretion, the authority to further delegate TSI certification authority.

24. Regional Foresters, Forest Supervisors, and District Rangers will issue similar priority guidelines and establish priority lists for stand improvement projects in accordance with the instructions in FSM 2472.3 for reforestation priorities. Stands in which cultural treatments will yield the highest multiple-use benefits and economic returns per dollar expended ordinarily should have highest priority for financing with funds appropriated or allocated for timber stand improvement work.

25. Priority determination require assessment of both tangible and intangible benefits.

In going back over this list, studying it a little more closely, there appears to be a logical breakdown into four separate categories, each with five to seven elements.

I suppose I should have taken the time when I got to this point and rearranged the list, but I decided against it. For our discussion purposes this morning, it won't make all that much difference anyway.

I can see you're all sitting there anxiously waiting to find out what the four categories are so you can get right to work on them. O.K. here they are.

The first one I've called Multiple-Use Consideration and Assessments. It includes Nos. 1, 3, 7, 10, 20, 24, and 25 of the original list.

This, in my estimation, is the area where we have the biggest and most difficult job ahead of us. When it comes to assessing intangible benefits of reforestation and TSI programs and projects, we're starting at a point just a bit off dead center. There are some schemes and computer programs available to assist in the analysis phase, but this doesn't solve the problem of providing valid input data.

I haven't delved into this very deeply yet, so I can't tell you exactly how we're going to attack the problem. I'm looking for help the same as the rest of you. A 1977 publication from NCFES recently came across my desk that I feel may provide some concepts and methods appropriate for this task. It's Research Paper NC-142 by John S. Crosby; "A Guide to the Appraisal of Wildfire Damages, Benefits, and Resource Values Protected" I mention this one because it is new.

Just a final word on this category. I would urge that the final direction that comes out on assessing intangible benefits would emphasize that the assessments be made during land use planning or on a program basis rather than for individual projects.

The second category I have called Examinations and Certifications. It includes Nos. 1, 14, 15, 16, 17, 18, and 23.

Here we are dealing basically with the requirement for making first and third year regeneration examinations. But it also includes the requirement to certify both the success of the regeneration and accomplishment of TSI. That sounds simply enough, and perhaps it will be. However, I see a need to reevaluate our existing definitions, survey methods, and standards. The more timber types and conditions you have, the bigger the job.

Certification should not be a problem: You either have successful regeneration or you don't; or you accomplished the TSI or you didn't. And hopefully, the TM subsystem of INFORM will be able to handle the documentation.

I would also like to point out some problems here that need resolution. For every good rule, there are exceptions. It is the exceptions that are the problem and I see nothing in the present text that speaks to recognition of the exceptions or how to handle them. The exceptions as I see them inappropriate. We have situations where a stand can be certified as successfully regenerated after the first year. We also have those that cannot be certified after the third year - nor the fifth year for that matter. This fact was recognized over five years ago in the Chief's first document on timber productivity: " ": the forerunner of the Action Plan. It is still just as valid today. There must be some direction to the Regions that gives recognition to these situations and how they should be handled.

The third category I have called Planning, Funding, and Controls. It includes Nos. 4, 5, 6, 21, and 22.

There are some significant new elements that enter the picture here. Specifically, they deal with planning for the activities and fund needs for purposes other than timber production under other-than-timber systems. Also, the handling of carryover reforestation monies and targets, and their reprogramming.

The major task will be to make sure that adequate systems are developed to handle them. They have to do with the planning and financial control procedures. I feel we in timber management often times get caught up in the whirlwind of these systems primarily because we don't have adequate input in the initial phases of systems development. After that we have to conform to a set of procedures that don't quite do the job for us. Something must be done to prevent that from happening.

I don't see that working with the current instructions in FSM 2496 for needs, schedules, funding requests and keeping track of backlog will be any problem to us. At least no more of a problem than it is now.

The fourth and final cateogry is somewhat of a catch-all. I didn't call it that though. Instead I used a catch-all title, Specifications and Guidelines. Though many of the requirements in these remaining elements (Nos. 8, 9, 11, 12, 13, 19, and a repeat of 24), are currently in effect, it is going to be necessary to reassess all of them. How big a job this turns out to be will depend on how up-to-date current guidelines are.

I do suspect that guidelines on priorities may have to be revised. How far we can go with this before we have completed some of the assessing of intangible benefits (covered under the first category), I hesitate to say.

I can't visualize such specifications and guidelines as regard origin of seed and stock, standards for planting and planting stock as requiring major revisions. And safety procedures for poisons and repellants are already pretty well spelled out.

So that covers it. I doubt that I've told anyone anything they didn't already know or wouldn't have been able to figure out for themselves.

I'm looking forward to the rest of the meeting in hope of getting some ideas and help for those problem areas where we still do have some work to do.

Presented by Jack Todd

Implementing Section 4 - Modifications Needed Regionally

In Region Six we have not yet devoted a great deal of attention to the implications of implementing section 4. Therefore, what I have to say is tentative and reflects a timber viewpoint rather than a regional consensus.

To begin with, I urge great care at both regional and national levels in avoiding overly specific direction which will increase our vulnerability to successful litigation. Whenever possible we should be guided by the common sense intent of Congress. We should resist temptations to establish any additional guidelines or rules not actually required to meet the intent of the Act.

For example, the Act clearly authorizes vegetative manipulation to obtain multiple use benefits. But the Act does not direct specific manipulations or results; it leaves resolution to land management planning. Thus, there is no need to rush into print with rules governing stocking levels, species composition, etc., which are perceived to be necessary to meet non-timber needs. Rather, individual land management plans should develop rationales for varying from normally accepted timber management practices in order to meet other plan objectives. Where we will most need consistency is in determining and displaying the tradeoffs of alternative actions and this is where we should devote our energies.

A major problem in Region Six will be to avoid accelerating the already hot argument over timber production. Particularly in the State of Oregon, there is great pressure to increase National Forest harvesting so as to offset projected declines from private lands. We are committed to do so to the extent which increased investments in cultural work will permit. Thus, expenditures for vegetative manipulations not designed to benefit timber production may be highly controversial. It will be argued that we must concentrate on timber-benefiting work so long as there remains any to do.

I believe our best approach is to seek funds for non-timber related vegetative manipulation only to the extent that the need has been established in approved land management plans. Where plans now in effect are not sufficiently specific, it should be possible to file environmental statements which cover addendums to current plans. Armed with public inputs, we will be in much better position to decide upon the tradeoffs among resources and competing uses which are appropriate for specific units of the National Forests.

Cost benefit analysis is one tool we will want to use in making such decisions. However, given the differences of opinion about how to make such analyses even where only tangible values are involved, I am not optimistic that we can use such analysis where intangible values are involved. Rather, we should concentrate on quantifying and displaying effects on outputs. For example, we need to show much more clearly the probable effects on such things as wildlife populations from alternative timber harvesting levels. Conversely, we need to show the effects on potential timber harvest levels from alternative wildlife habitat objectives. Given a clearer picture of the tradeoffs, the public can better respond to our requests for input.

While the Act clearly seeks to prescribe a level of management which will avoid the problems of the past, we need to be careful not to suggest that we will henceforth make no mistakes. For example, we must try very hard to avoid harvesting where regeneration cannot be accomplished in five years. However, if we limit harvesting to situations when regeneration is absolutely assured, we will reduce harvest levels significantly. I believe we should establish standards which provide reasonable assurance, and at the same time, set up monitoring systems which will alert us immediately when timely regeneration is not being achieved so that standards can be changed. If we must guarantee regeneration within five years, we probably cannot prescribe natural regeneration in Region Six.

This will mean that our nursery capacity must be increased. Some increase in capacity appears needed even if we can continue to plan on some natural regeneration.

Finally, we will need to do a much better job of documenting the kinds and adequacy of the work we do even beyond the specific requirements of the Act. Because of the interest generated by debates on the Act, the public as well as Congress increasingly will insist on proof that what we say we are doing is evidenced on the ground. More specific, and restrictive, legislation is probable if we fail. In that event, our ability to achieve the very best timber management on the National Forests is likely to be reduced.

Presented by Don Strode

National Silviculture Workshop
September 26-30, 1977
Flagstaff, Arizona

Panel - Appropriate Vegetation for the Resources

INTRODUCTORY STATEMENT

The National Forest Management Act of 1976 establishes new policies and guidelines for forest resources under the concept of multi-use and sustained yield management. Section 4 (Reforestation) is certainly not an exception. (d)(1) states: "It is the policy of Congress that all forested lands in the National Forest System should be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans." It further states: "The level and types of treatment should be those which secure the most effective mix of multiple use benefits." These and similar statements indicate it was the intent of Congress that reforestation should achieve multi-resource outputs.

In examining (d)(1) Section 4 we note that Congress did not authorize activities that could not have been done through existing authorities. However, without this mandate we should perhaps ask ourselves if whether our reforestation projects are directed towards achieving multi-resource present outputs. With exceptions, I would answer in a negative manner.

If we are to achieve the intent of Section 4 multi-resource outputs, it is necessary that we be able to prescribe reforestation requirements

of all forest resources to meet land management objectives. Hopefully, this panel is a step towards achieving this need.

GUIDELINES TO MAINTAINING OR ENHANCING WILDLIFE HABITAT VALUES THROUGH TIMBER MANAGEMENT

Edward R. Schneegas and Charles Sundstrom

Northern Region, Forest Service, Missoula, Montana

INTRODUCTION

Wildlife habitat improvement has mostly been a by-product of management actions taken primarily for other purposes. Public emphasis on the management of wildlife resources is increasing, as well as demands for wood fiber. It has become incrasingly obvious that benefits to wildlife must be planned for in advance and not be achieved accidentally. As the forest changes -- so do the animals.

Lack of basic research information to coordinate wildlife and timber management is not the biggest problem. The lack of a conceptual framework to allow (1) consideration of all vertebrate species, (2) ability to emphasize a particular species, and (3) identification of specific habitat requirements requiring special attention has been the major problem.

The continued generalization that all timber management accrues benefits to wildlife habitat is no longer acceptable. We must develop and implement specific procedures, predict consequences and recommend positive strategies to increase wildlife habitat outputs from timber management. The goal of our participation in this silviculture workshop is to demonstrate how purposeful results in terms of wildlife can be obtained through vegetative manipulation and an intensively coordinated timber management program.

THE RELATIONSHIP OF VERTEBRATES TO FOREST COMMUNITIES AND SUCCESSIONAL STAGES

All vertebrates can be divided into 16 life forms based on a combination of requirements for reproductive and feeding habitats.

(Table 1 attached.)

Table 1. Description of vertebrate life forms.

Life form number	Reproduces	Feed
1	in water	in water
2	in water	on ground, in bushes and/or trees
3	on ground around water	in water, on ground, in bushes and trees
4	in cliffs, caves, rims and/or talus	on ground or in air
5	on ground without specific water, cliff, rim, or talus association	on ground
6	on ground	in bushes or trees or air
7	in bushes	on ground, in water or air
8	in bushes	in bushes, trees, or air
9	primarily in deciduous trees	in bushes, trees, or air
10	primarily in conifers	in bushes, trees, or air
11	in trees	on ground, in bushes, trees, or air
12	on very thick branches	on ground or in water
13	excavates own hole in a tree	on ground, in bushes, trees, or air
14	in a hole made by another species or naturally occurring	on ground, in water, or air
15	underground burrow	on or under ground
16	underground burrow	in water or air

Animal response to alterations of a plant community can be predicted. Silvicultural treatments on life forms can be anticipated in terms of either advancing or retarding succession.

The ability of a species to adapt to change can be evaluated in terms of the number of plant communities and successional stages required for reproducing and feeding. The greater the number of plant communities utilized the more adaptable the species; the fewer successional stages and plant communities used, the less adaptable and the more vulnerable the species is to habitat change.

THE RATIO OF FORAGE AREA TO COVER

Classic wildlife management theory says the three components of habitat are food, cover and water. The ratio of cover to forage openings and the juxtaposition and arrangements of cover and forage areas in time and space are extremely important. Most literature indicates a ratio of about 40 percent cover to 60 percent opening will assure maximum use by elk and deer.

Cover is divided into two types; hiding and thermo. Hiding cover is defined as vegetation capable of hiding 90 percent of an elk at 200 feet or less.

Thermal cover aids elk and deer in maintaining body temperature during cold winter periods. It is defined as stands of coniferous trees 40 feet or more

tall with an average crown closure exceeding 75 percent. Optimum size for thermal cover is 30 to 60 acres. Areas less than 30 acres are too small to protect animals from wind movement and to accommodate a herd of deer or elk.

Forage is produced to some degree on all openings. Created openings receive as much or more use than natural openings. For maximum elk use such areas should have no point farther than 600 feet from cover. This allows forage areas up to 1,200 feet wide to qualify as optimum. Elk cover requirement can be met in terms of forage/cover ratios and cover per se, under a variety of rotation ages and management intensities. It is largely a matter of locating timber cuts and timing regeneration. The important point is that simultaneous elk-timber production goals can be met. Obviously, other management schemes are necessary; human disturbance and roading.

SPECIAL AND UNIQUE HABITATS

These include; riparian, snags, edges, cliffs, talus, and caves.

Snags are defined as completely or partially dead trees and at least 10 feet tall. They are either soft or hard. Some 38 bird species and 24 mammals are dependent on snags in Montana. The birds are insectivorous with the role of controlling forest insect pests. The absence of suitable nest sites is usually the major limiting factor.

SUMMARY

From this rather brief overview, we hope we have demonstrated that even greater benefits to wildlife through timber management can be achieved. In the short time provided -- it would be impossible to cover the entire system in detail.

Such a system can be used in (1) preparation of E.I.S.'s, (2) land use planning, (3) guidance for integrating silvicultural prescriptions to increase wildlife outputs, and (4) describe habitat preferences of all vertebrates.

The information can be computerized to yield rapid predictions of wildlife populations in a managed forest over time.

LITERATURE

Thomas, Dr. Jack Ward, et al., 1976. Guidelines for maintaining and enhancing wildlife habitat in forest management in the Blue Mountains of Oregon and Washington. Trans. 41st. North Amer. Wlde and Res. Conf., Publ., Wldl. Mgmt. Inst., Washington, D.C. p 452-476.

Appropriate Vegetation for the Resources -- Watershed*

John F. Corliss

Several statements in Section 4 of special interest to watershed management staff refer to maintaining appropriate cover of true species, maintaining growth rates, determining productivity, reforestation of denuded areas, growing seedlings, preparing sites, and removing deleterious growth. Soil and water scientists can provide a significant contribution to both planning and evaluating results of soil and vegetation modifications. Effects on soil and water can be monitored to assure maintenance of sustained yield potential not only of the physical and chemical aspects of the soil growth medium but also on water timing, yield, and quality.

Activities specified in Section 4 are to be done in accordance with land use plans. It is important that silviculturists as well as soil and water specialists understand and participate in the planning process. It is in these plans that resource production and service levels are identified. It is also here that trade-offs or synergisms are recognized and evaluated. The planning activity of Section 6 and the subsequent revisions of those plans will set the guidelines for land management targets. Water is one of those targets. In some areas, and not necessarily limited to the western regions, water targets identified in these plans are going to have heavy impacts upon our vegetation modification plans. In some cases, demands will change so drastically and quickly that plans will have to be revised in shorter intervals than the normal 15-year span. Demands for water will have impacts upon species selection, stand densities and age classes, and undergrowth management. Also, modification of certain soil and geologic properties affecting infiltration and percolation in recharge areas will be needed. Both of these affect the day-to-day operations of the silviculturist. Furthermore, in areas of rapidly changing water needs, the modification of soil or vegetation characteristics may be on a much shorter time frame than a planned rotation.

At present, the Forest Service is in a transition period with respect to water resources. The agency is assuming a more active role in water resources management as opposed to a passive role of protection. Silviculturists will serve as important catalysts in designing plans and prescriptions to achieve these new and changing targets.

* Presented at National Silviculture Workshop, Flagstaff, Arizona; September 26-30, 1977.

Presently, the agency is faced with a number of choices with respect to lands for which there is little desirable product--the denuded lands. Many of these tracts have negative product aspects, namely sediment production and flashy water runoff. Decisions on the potential for many of these lands have yet to be made. Many are targets for watershed restoration. With the improved funding of FY 1977 and another sizable increase in FY 1978, watershed restoration of denuded lands on the RPA backlog is accelerating. Before treatment, the long-term potential should be recognized. Treatment plans for return to timber production may be quite different than if only watershed, or watershed range and wildlife uses are anticipated. Sensitivity of the site to certain treatment activities may further affect its utility and the treatment plan. Sites which are occupied by undesirable species or are denuded are, in a few cases, the result of sale or post-sale activities. Timing is frequently a factor in such situations. Slash disposal or planting or inappropriate soil treatment has permitted highly competitive species or species of little value to get started or to achieve a growth advantage over planted stock. The follow-up renovative treatment frequently has a heavier impact upon water quality adjacent to the site than if such follow-up had not been necessary.

Funding for treatment of lands not appropriately stocked or denuded may be funded from a variety of sources. Watershed P&M has been mentioned. P&M reforestation as outlined in Section 4 may be appropriate. Section 18 of the NFMA amended the KV Act so that certain soil and water management activities may now be funded from this source. A suggested set of priorities for selecting among some examples of soil and water management opportunities on the sale area follows. This work must not result from current sale operations which should be done with cooperative deposit funds.

1. Priority 1 might include that soil treatment, water spreading or drainage which will improve the long-term productivity of the site. Soil treatments which would permanently break up root-restrictive pans or compacted soil material are worthy of consideration.

2. Priority 2 could include those sites needing protection from further deterioration.

3. Stabilizing stream channels which are meandering into productive bottomland sites would be an example of priority 3.

4. A fourth priority might include stabilizing stream channels which would benefit water quality fisheries, recreation, and other uses but not have any appreciable effect upon timber productivity.

Of course, any of these situations would require close multi-disciplinary coordination and a comparison of costs to benefits.

In summary, benefits accruing to the soil and water management targets rely heavily upon the sensitivity, knowledge, and coordinative skills of the silviculturist. It is his close attention to planning, execution, and follow-up monitoring which can greatly affect the capability and efficiency of a land area to provide water of suitable quality, appropriate timing, and adequate supply. In like fashion, the skills of water and soil scientists can provide practical technical advice to assist the silviculturist to more effectively, efficiently, and economically meet the intent and direction of the RPA and NFMA of 1976.

Presented by Bill Pint

Implications for Range Management Inherent in the National Forest Management Act

As near as I can determine from the scanty information given me, I am supposed to impart to you my thoughts on the implications for range implicit in the National Forest Management Act, especially section 4 and in the amended K-V Act.

I don't have any grand slides to show you to illustrate how we have rushed out and fully implemented the Act on the Tonto National Forest, which has an astounding allowable saw log cut of approximately 4 MMBF. This is not to say we do not have opportunities for enhancement of range under the Act, small as our timber program may be; I'm afraid what it does mean is that functional specialists have not yet begun to fully communicate and coordinate. I suspect we are not unique in this respect. I will say more about this needed interface later.

3. Section 4 of the Act says, "It is the policy of the Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans." Further on in the same section it directs us to "establish and improve growing forests to secure planned production of trees and other multiple use values.

The Chief's proposed policy, published in the Federal Register in early 1977, says that. "K-V funds will be collected and used to the fullest practical extent to protect and improve the future productivity of the various renewable resources on timber sale areas". Activities included in the SAI Plan must meet certain criteria such as: 1) be compatible with existing land and resource management plans for the area; 2) meet the basic forest management needs identified in the land use plan for the area and 3) be multiple use activities of mitigation and enhancement needed on the sale area".

You will note that in all of the above quotations a great deal of reference is made to the existence of land management plans which are to direct coordination and promote harmony between the various resources on sale areas. In reality, we are a long way off from the realization of this utopian state of affairs. Thus the need for improved communication and coordination between the District Range Conservationist and the District timber beast if we are to fulfill either the intent of the Act or the Chief's Policy.

4. What can we do for each other and for the timber and range resources if we work together? Lets look at a few examples; there are many others too numerous to mention, but just for illustration sake:

Prior to the Act and the new Chief's Policy statement, the seeding of grasses and forbs on soils disturbed by sale activities

was limited to that necessary for erosion control. One could also build fences around seeded areas to help foster ground cover establishment. The intent was to prevent or lessen soil loss, nothing more. Of course there were other benefits implicit in the practice such as aesthetics enhancement, wildlife habitat enhancement and, depending on the species included in the erosion control seed mix, some increase in range forage as well. I think the Act and the Chief's Policy directs us to do more than settle for passive improvement in range forage at best or no improvement, or a net loss in the forage available on the sale area, as is often the case if we ignore coordination and improvement opportunities. Working with the range con., I believe silviculturists can come up with a seed mix that will increase the quantity and quality of forage available, though admittedly that forage is usually transitory or temporary in nature, as stands are opened up by timber harvest. With careful attention to species selection, concentrating on those offering the ~~best~~ least competition with tree seedlings, and then applying seeding rates and timing that results in moderate forage stand densities, I believe we can meet <u>both</u> timber and range improved yield objectives. The net increase in forage on one sale area may well be the key to caring for the permitted livestock while they are excluded from a future plantation or regeneration area on another portion of the allotment. If the two disciplines will <u>really</u> make an effort to work together they might determine that it makes little sense to build a temporary fence around the regeneration area when a marriage of range and K-V funds (where this can be done within the sale area) could

better serve to create a new pasture or allotment sub unit, which might later serve to protect a future reforestation effort in another area on the grazing allotment. In short, the dove tailing of timber and range plans will be essential to meet the intent of the Act. In my opinion and experience each discipline has done its own thing for too long!

I believe greater use of soils expertise will be necessary if we are to secure the maximum benefits of multiple use sustained yield management as directed in the Act.

For instance, there are marginal sites on the Forests here in Northern Arizona that were cut over many years ago and are not now fully stocked according to the customary yardstick applied to assess reforestation needs. (It was my observation, however, that many of these old stump fields had a stocking level of young trees which was roughly equal to the number of stumps present). Thus, plans were made to plow the excellent stands of native grasses present in order to increase the stocking of the sites through reforestation. I believe we need to make a greater effort to determine the maximum benefits from an economic and social standpoint on such areas. These areas are also important from a wildlife standpoint. Perhaps a better prescription to achieve the objective of maximum benefits to multiple use sustained yield management would be to leave such areas alone or to at least recognize the contribution they are making to the yield of other outputs and

to modify business as usual site preparation techniques to minimize damage to the other resources. It became apparent to me that we had a problem in this regard when, a couple of years back, we were asked for input into the determination of resource capability, projected to the year 2020. I was planning on such marginal timber sites, which have a moderate to high forage production potential, to sustain certain AUM levels on the Forest, only to learn that the timber staff officer planned to increase his timber outputs by converting the productive range sites to weed fields through plowing under the forage resource. For certain one or the other of use (likely both) could not meet perceived targets in 2020. Hence the need for a higher level of multi-disciplinary professionalism to get the multiple use job done.

Since the quantity and quality of forage produced under a timber canopy is largely a function of the amount of light that reaches the forest floor, thinning prescriptions and thinning slash cleanup alternatives might be cognizant of a potential for enhancement of the forage resource (although I realize they cannot be dictated by it.) Some study has been done on the comparative economic returns from wood products and range forage when various thinning prescriptions were employed. A surprising amount of range forage can be fostered through TSI efforts. I have also been told of a reforestation technique being used in the SE whereby two rows of trees are being planted closer together than normal in staggered fashion in order to leave maximum distance between each pair of rows and the adjacent pairs on either side, to maximize forage

production. At the appropriate time each pair of rows is further thinned through pulping operations and maximum forage production continues. I have not seen this, I have only been told it is being practiced. I mention it only to illustrate the innovative thinking which must prevail if we are to achieve "the maximum benefits of multiple use sustained yield management."

I now stand stripped of pretense before you awaiting your best shots.

Reforestation and the Endangered Species Act of 1973

William D. Zeedyk

Introduction

Other speakers in this workshop have frequently quoted Section 4(d)(1) of the National Forest Management Act (NFMA) and Section 6. I will not risk quoting them again. It is clear that reforestation, or aforestestion, will be for multiple-use sustained-yeild purposes in accordance with land management plans and that maintaining the diversity of plant and animal communities will be an objective of such plans, Section 6(g)(3)(B). Sections 4 and 6 provide for multiple-use.

Thus, Section 4, NFMA and the Endangered Species Act are apparently compatible. There are no repealers in NFMA amending the Endangered Species Act of 1973 (ESA) thus, we must assume that Congress intended for the Forest Service to adhere to both in the administration of National Forest System lands. Further, the Chief has repeatedly stressed strong support of the ESA, indeed, solidly backing the purposes of the Act whenever precedent-setting decisions regarding ESA were in order. Hence, the Forest Service has a solid, credible and consistent record with respect to ESA, a record for which we can all be proud. The Forest Service has taken the ESA in stride.

The present weakness in Section 4 with respect to the present subject, is that land use planning is not that far along and completed plans often do not have essential information concerning endangered species and threatened species cranked in. There are numerous reasons for this, one being that species are still being listed by the Secretary of the Interior and plans are sometimes obsolete before they are completed. There is a continuing need to update existing plans.

Paper given by William D. Zeedyk, Endangered Species Specialist, Forest Service-USDA, at the National Silviculture Workshop, Flagstaff, Arizona, September 27, 1977.

Judging by recent court rulings, there can be little doubt that, in a real conflict, the requirements of ESA would prevail over other multiple-use values. Presently, about 60 listed species of wildlife and at least 400 plant species proposed for listing occur on NFS lands. Endangered and threatened species include mammals, birds, fish, reptiles, amphibians, invertebrates, and plants. Only certain nuisance species of insects are specifically exempted from protection under the Act. The potential encounters between FS programs for conservation of listed species and other management programs, including reforestation, are many, but resolvable.

I believe foresters as land managers have the ability to blend the requirements of the two Acts. Silviculture holds the key if silviculture is the art of growing trees to produce the many values that man desires from trees, not merely wood products. Silvics is the science that supports this art and provides us with the knowledge to manipulate forested ecosystems for whatever purpose. Perhaps "ecoculture" is the role of silviculturalists.

Key Points in the Endangered Species Act of 1973

I feel that the following excerpted passages from the Act are most vital to the FS mission.

> "Section 2(a) Findings - The Congress finds and declares that--
>
> . . . (3) these species of fish, wildlife, and plants are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people; . . . ."
>
> "(b) Purposes.--The purposes of this Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps

as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section.

"(c) Policy.--It is further declared to be the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act."

Definitions

"Sec. 3. For the purposes of this Act--

. . . (2) The terms 'conserve', 'conserving', and 'conservation' mean to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking."

Interagency Cooperation

"Sec. 7. The Secretary shall review other programs administered by him and utilize such programs in furtherance of the purposes of this Act. All other Federal departments and agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs

for the conservation of endangered species and threatened species listed pursuant to section 4 of this Act and by taking such action necessary to insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of such endangered species and threatened species or result in the destruction or modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with the affected States, to be critical."

The key direction embodied in both Section 2 and Section 7 is that agencies shall "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species."

This means that all other authorities including the reforestation direction in NFMA shall be used where appropriate and applicable for the benefit of listed species. Falling back on the definition of "conserve," if a practice is recognized as being beneficial or potentially beneficial, we should do it. Really, we must do it.

Section 7 further directs that Federal agencies must insure that their actions do not jeopardize species or destroy or modify habitats determined to be critical.

These statements of congressional direction leave room for judgment on the part of the agency to determine, in consultation with the Secretary of the Interior, the significance of a proposed action.

Hallmark Cases in the Interpretation of the ESA

Mississippi Sandhill Crane Case -

Involved the Department of Transportation and the construction of an interstate highway through the critical habitat of the bird in Mississippi. The court found that the Federal agency must observe ESA, must consider the needs of listed species, must consult with the Secretary of the Interior (Fish and Wildlife Service), and must determine and avoid both direct and indirect effects of an action.

Indiana Bat Case -

Involved the U.S. Corps of Engineers and the Indiana Bat in the construction of a reservoir in Missouri. This case reaffirmed that agencies must consult but need not necessarily acquiese to recommendations of FWS as embodied in the biological opinion resulting from consultation; significance and timeliness of the action were factors in the case.

Snail Darter Case -

Involving Tennessee Valley Authority in construction of a dam which would jeopardize survival of the Snail Darter and destroy its critical habitat. Construction was halted on appeal to the Supreme Court. The court established that an action may be stopped at any point short of completion if requirements of ESA would be violated in completing the action.

Red-cockaded Woodpecker -

Involved forest management practices and cutting planned on the National Forests in Texas. FS was sued in violation of four Acts including the Endangered Species Act. The court found that the FS was not in violation of ESA. FS management guidelines were based on current state-of-the-art and adequately

documented; FS had consulted with all knowledgeable State, Federal, and private experts, guidelines were properly applied and administered on the ground as planned. The case reaffirmed that agencies are responsible for their actions.

Bachman's Warbler Case -

This nationally celebrated case, involving timber management activities on Francis Marion NF, did not go to the courts, but was settled under mediation by a three-man panel of biologists selected by the Forest Supervisor and the prospective plaintiff under urging of National Wildlife Federation. This case demonstrates that the courtroom may not be the appropriate arena for resolving issues of biology. Agencies must have biologically sound management strategy, properly applied on the ground and adequately documented.

Interagency Cooperation - Consultation

The Fish and Wildlife Service and the National Marine Fisheries Service are in the final stages of preparing Secretary's regulations providing for consultation and consultation procedures as required by Section 7.

The proposed regulations met with stiff resistance by other Federal agencies and were the subject of review by the Office of Management and Budget. Word has it that the draft final regulations contain substantial revisions responsive to agency concerns expressed at the OMB meeting, but that consultation will be mandatory.

The Forest Service now proposes to consult on the basis of a comprehensive species management plan for each species falling under FS land management jurisdictions. Effects of management programs will be assessed by function and standard mitigation measures will be proposed for the review of FWS.

It is hoped that this approach will take full advantage of FS expertise in endangered species management, and minimize the frequency of consultation events by eliminating consultation for recurring or similar activities. The Forest Service has minimized consultation pending final publication of the procedures. We have consulted on the Grizzly Bear in Montana, the Red-cockaded Woodpecker in Texas, the Eastern Cougar in North Carolina, and the Black-footed Ferret in Nebraska.

We have had several hundred consultation events conducted informally and involving most species found on NFS lands.

President's Memorandum on Critical Habitat - May 23, 1977

In conjunction with his Environmental Message of May 23, 1977, the President issued a directive to the Secretaries of Interior, Agriculture, and Defense, and the Chairman of the Tennessee Valley Authority, to accelerate the protection of critical habitats. In brief, the memorandum directed the Secretaries to:

1. Expedite the inventory and identification of critical habitat;
2. Make such information available to the Secretary of the Interior;
3. Manage these areas to protect them and to consult with Interior on such protection, and
4. Call on the States and local authorities for assistance and advice in identifying such areas.

Interior has the added responsibility of:

1. Setting timetables and criteria;
2. Assisting agencies in accomplishing listed tasks, and
3. Expediting formal determinations of critical habitats.

The FS has responded by preparing direction to the field, establishing interim timetables and procedures pending further advice from the FWS. A formal meeting with FWS at the national level is planned for November 1977.

Progress in implementing the President's Memorandum is apparently being monitored by CEQ.

On Relating Section 4 NFMA to ESA

First, the conservation effort for listed species must be appropriate to the ecological and behavioral needs of the species, with recovery of the species being the goal of management. Merely maintaining a relic population is not sufficient. In some cases, land managers have the knowledge, research backup and capabilities to do this, in others, no, but the know-how is evolving. When technology is lacking, simple protection of the habitat, rather than improvement, is the mode until technology can catch up.

There are no panaceas in the conservation and recovery of listed species. Recovery efforts must be tailor made to fit the biology of the species and remove the limiting factors which suppress populations. FS research is underway with about 39 species. Administrative studies under contract with other institutions are providing additional information.

Most vital to timber production are those species whose needs affect the management of large acerages or high productivity sites--the Red-cockaded Woodpecker, Grizzly Bear, Bald Eagle, Kirtland's Warbler. On the otherhand, the imaginative application of silviculture in the manipulation of habitat is vital to the survival of those species having narrowly defined niches in forested ecosystems. These include the Puerto Rican Parrot, many plant species proposed for listing, and again the Kirtland's Warbler, Bachman's Warbler, and Bald Eagle.

To modify silvicultural application to fit the recovery effort for a species, we must know how silviculture affects the ecosystem and the habitat over the short run and the long run, and evaluate the effects of silvicultural-related disturbances on the behavior of the species during critical times in its life cycle. Then we must also weigh any trade-offs between short-term and long-term effects. Since most habitats are dynamic and change with normal plant succession, short-term impacts may be essential to achieve long-term benefits, or conversely might be safely deferred.

The Endangered Species Act provides no guidance here, nor do the inter-agency guidelines, thus this matter will be essentially up to affected agencies to resolve on a case-by-case basis.

Success, over the long run then, depends on developing a rational strategy of ecosystem management which depends on the acceleration or retardation of normal successional processes as the species may require. For example, some species may require even-aged management systems and seral plant communities for survival while others may depend on all-aged management and the presence of older-aged or climax forests for their needs.

Silvicultural practices deserving a close look include:

Aforestation of lands never forested or long in non-forest condition such as bogs, marshes, meadows, old burns, and wet pine flatwoods of the South. For example, drainage, bedding, and planting of pine flatwoods within the critical habitat of the Sandhill Crane would be adverse to the habitat requirements of that species. Backlog areas should be reexamined to be certain that aforestation would not be in conflict with endangered species recovery objectives.

Type conversion of certain forested types to alternative tree species could be adverse. An example is conversion of jack pine types to red pine or hardwoods in the case of the Kirtland's Warbler, or of Southern yellow pine to hardwoods in the case of Red-cockaded Woodpecker. The selection of species to be planted in the reforestation of unsatisfactorily stocked backlog areas may be important.

Site preparation methods may be beneficial or adverse. Prescribed burning for site preparation is beneficial to the Kirtland's Warbler and early successional plants, but could be adverse to others. Chopping, as a site preparation practice, is thought to be destructive of at least one woody shrub proposed for listing, Baptisia arachnifera.

Timing of site preparation or planting activities may be critical if conducted while migratory species are present, but insignificant during other seasons; examples include Bald Eagle and Peregrine Falcon.

Summary

Endangered species management and reforestation objectives are or can often be made to be compatible. Wherever possible, a goal of forest management should be to create or recreate suitable habitats through dynamic growth processes stimulated, modified, or controlled through silvicultural methods and applications. If we can show that habitat management through modified silviculture can create and stabilize the distribution of quality habitats, the need for set-asides and intensive manipulation will be minimized, leaving silviculture with more options rather than fewer over the long run.

Special attention should also be paid to rare or declining species to assure that essential habitat diversity is maintained to supply their needs, too. We do not want to be responsible for adding more species to the endangered list, rather, we want to use timber management creatively to keep species out of trouble and off the list.

There is little reason for forest management to fear the Endangered Species Act, although there are some problems. Endangered species are native renewable resources of the forest. Forest managers have skills which may be applied in a variety of ways to conserve vanishing species in harmony with other multiple use objectives. Where listed species may be involved, we need to be thoughtful, thorough, and objective in the selection of areas to treat and methods of treatment and careful to document the validity of decisions affecting listed species and their habitats.

National Silviculture Workshop
September 26-30, 1977
Flagstaff, Arizona

POTENTIAL VEGETATION AS AN INDICATOR OF REFORESTATION OPPORTUNITY

by

Robert D. Pfister and Raymond C. Shearer[1/]

INTRODUCTION

Successful implementation of the Reforestation Section of the National Forest Management Act will require a concerted effort by all silviculturists in the USDA, Forest Service. Available skills, tools and knowledge must be utilized to their maximum potential. Some new tools and knowledge will also be needed.

Our purpose in this paper is to review possible applications of potential vegetation classification to accomplish the Reforestation goals of the Act. In order to do this, we will focus on (1) status of potential vegetation classification work in the United States, (2) examples of applying these classifications to reforestation problems, and (3) a discussion of opportunities for summarizing existing knowledge of reforestation requirements on different sites.

Before we embark, however, we will look at the Act and review the key points and general relationships to potential vegetation (habitat type) classification.

GENERAL INTERPRETATION OF SECTION 4, NFMA 1976: REFORESTATION

Section 4 of the National Forest Management Act of 1976 specifies "that all forested lands in the National Forest System shall be maintained in appropriate forest cover...designed to secure maximum benefits of multiple use sustained yield management in accord with land management plans. The general relationships of this policy to potential vegetation (habitat type) classification can be expressed for each of the four major factors listed under "appropriate forest cover":

1. Species of trees.--Detailed potential vegetation classifications define the natural occurrence and successional roles of tree species for each type, thereby establishing ecological guidelines for selecting appropriate species. Silviculturists have taken this one step further in development of preferred species lists by habitat types for each National Forest in the Northern Region.

1/ Principal Plant Ecologist and Principal Silviculturist, Intermountain Forest and Range Experiment Station, Missoula, Montana.

2. Degree of stocking.--Early work in Oregon by Fred Hall indicated that some habitat types (especially warm-dry sites) have inherent stockability limitations that severely reduce yield potential. Later studies in Montana and Idaho emphasize the necessity of recognizing this natural relationship in developing stocking guides for certain habitat types.

3. Rate of growth.--Growth rate is influenced by the degree of stocking and by site factors. Site factors are reflected in habitat type classification and natural stand yield capabilities have been calculated as part of several habitat type classifications. The growth prognosis model being developed by Al Stage of the Intermountain Experiment Station uses growth coefficients that are tied to habitat types.

4. Conditions of stand.--Stand conditions may vary greatly between and within habitat types. A portion of this diversity is defined within the descriptions and data base of potential vegetation classifications. The classifications provide a convenient foundation for refining descriptions of stand conditions and for establishing desired stand conditions.

In addition, Congress has specified that estimates of funds necessary for reforestation and other treatments may be submitted for the following kinds of work--several of which are related to potential vegetation:

1. Secure seed.--Habitat type classification offers an appropriate means of designating seed collection zones because of the natural environmental stratification it provides. New seed collection and transfer rules, tied to habitat types, were established for Northern Region Forests in 1975 to ensure quality control of seed source in artificial reforestation.

2. Grow seedlings.--Potential vegetation is generally not applicable to nursery operation except to retain the seed identity noted above.

3. Prepare sites.--Potential vegetation classifications provide general prediction of successional development following disturbance of plant communities. On some,scarification is necessary to eliminate root competition, while on others, relatively little disturbance will permit establishment of desired conifers. Habitat type classification provides a site identification foundation for future studies of early successional development following different treatments.

4. Plant trees.--Studies of plantations have demonstrated some strong relationships between habitat types and seedling survival as well as early growth. The factors of mortality may also vary by habitat types along with numerous other variables.

5. Thin.--National Forest species preference guides by habitat type are used for selection of crop trees in the usual mixed stands that develop on most of the Northern Region's forests.

6. Weeding.--Similar rationale as for thinning can be applied to designation of "deleterious growth and underbrush" by habitat types.

7. Fence.--The necessity of fencing to exclude grazing and wildlife from regeneration areas is partially related to the forage potential of early successional stages. In certain habitat types, animals are attracted by an abundant forage regrowth--fencing may be essential to protect tree regeneration. In other habitat types, fencing may not be a critical factor.

In all the points discussed above, numerous factors affect successful accomplishment of the kinds of work described. We are not suggesting that potential vegetation classification solves all problems--rather, where classifications are available, they can be used to help specify guidelines for successful practices.

POTENTIAL VEGETATION CLASSIFICATION

Concepts

When the term potential vegetation is used, one may think of Kuchler's (1964, 1966) maps of the "Potential Natural Vegetation of the United States". These types have been widely used for national contrast of environments with widely differing potentials for vegetative growth. However, they are rarely used for on-the-ground site identification because (1) the types are not precisely defined, and (2) a key has not been written to allow consistent use of the classification by different users.

Rather than trying to further refine this broad approach to classification, researchers have developed classifications of potential natural vegetation from the ground up--i.e., based on an actual data base obtained by sampling. Most of these classifications have utilized the term "habitat type" to represent the area of land occupied by a type of climax natural vegetation (association - sensu Daubenmire). These classifications usually include (1) a list of defined types, (2) a simple key to the types, (3) a description of the natural climax vegetation by species composition and amounts, (4) a description of the environmental

features of the habitat of each type, (5) a discussion of general successional trends for each type, and (6) some interpretations for managing the sites within ecological limits.

Classification hierarchy

The climax community type, or association, provides a logical name for the habitat type--for example, Pseudotsuga menziesii/Calamagrostis rubescens (Douglas-fir/pinegrass). The first part of this name is based on the climax tree species, which is usually the most shade-tolerant tree adapted to the site. We call this level of classification the series, and it encompasses all habitat types having the same dominant tree at climax. The second part of the habitat type name is based on the dominant or characteristic undergrowth species in the climax community type. A third level called the phase is used when necessary to recognize subdivisions of a habitat type--for example, the Agropyron spicatum (bluebunch wheatgrass) phase represents the warmest, driest portion of the Pseudotsuga/Calamagrostis habitat type. Single species names are used for each level of the taxonomic hierarchy to keep nomenclature simple, yet diagnostic.

Status of classification

Habitat typing as an approach to forest ecosystem classification was originally developed for northern Idaho and eastern Washington by Prof. Rexford Daubenmire (1952) of Washington State University. His system proved valuable for both research and management needs and served as a model for classification work throughout the western United States.

Increased activities during the late 1960's and early 1970's have led to completed classifications for more than twenty major areas in the western United States (Figure 1). At least twenty different scientists have been involved in these efforts. Although each classification carries some unique features appropriate to the particular study (and scientist), the classifications are[all]compatable in concept and utility (Pfister 1976).

We have recently used the term "taxonomic" to describe these classifications because they are provided with a key (similar to familiar keys for identifying plants) that permits foresters to consistently identify the types on the ground with minimum training. This particular feature greatly increases the utility of the classifications for management use.

To our knowledge, relatively little work on classifying potential natural vegetation types has been done in eastern North America. Westveld (1953) initiated some work about 30 years ago, but a formal taxonomic classification was never completed (Spurr & Barnes 1973, p. 259-260). Unfortunately, the value of Westveld's classification concept was not recognized as a site classification tool because of his emphasis on managing to favor climax species.

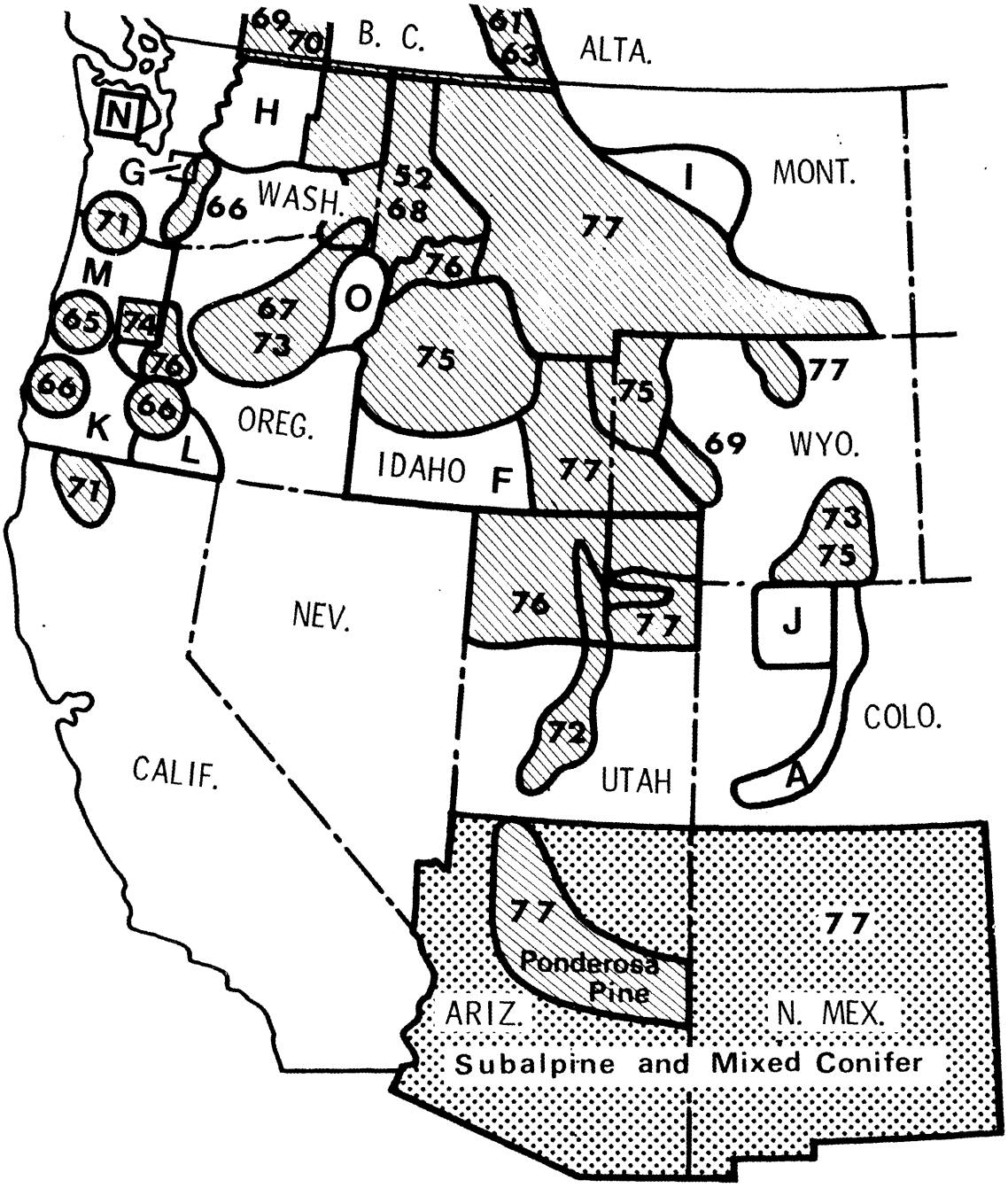

Figure 1. Status of forest habitat type classification in the western U.S. Numbers refer to the year when published or available to users as a working draft. Letters refer to studies in progress. (Updated from Pfister 1976)

Only a few potential vegetation studies of small areas have been conducted in recent years in the East. However, the USDA-FS Eastern Region is incorporating a potential vegetation classification in their Ecological Classification System (Personal comm., Tom Lennon, Regional Office, Milwaukie, Wisconsin). They plan to start out with pragmatic classifications except where and until when formal classifications are developed by research or universities.

Status of habitat type mapping

Use of a taxonomic classification enables foresters to identify the appropriate habitat type for individual stands as they conduct regular inventories, stand examinations, sale preparations, etc. When needed by the manager, a habitat type map of the area is prepared. Two levels of mapping are currently used in the northern Rocky Mountains.

Two-inch/mile maps are widely used for area planning (Layser 1974). Major portions of some National Forests have been mapped as each planning unit is developed. Several National Forests have been mapped in their entirety in conjunction with timber inventory (e.g., Deitschman 1973). These maps are especially suited for resource allocation and provide acreage estimates by habitat types for large areas. However, they do not provide the detail needed for project-level planning.

On projects like timber sales, thinning, reforestation and field experiments, maps of four-inch/mile to eight-inch/mile are often prepared in order to tailor prescriptions to the variability encountered. This is not to say that all projects must be mapped in detail by habitat types. However, it is essential to recognize habitat type variability within a project area and take necessary action to accommodate it, rather than apply blanket treatments over large areas having recognizable inherent ecological differences.

REFORESTATION KNOWLEDGE BY SPECIES IN RELATION TO POTENTIAL VEGETATION TYPES

Past studies of reforestation have usually been focused on problems within a forest cover type or for a given species. Both types and species extend over a broad range of environments and respond accordingly. A review of several studies illustrates how regeneration of given species varies by potential vegetation types.

Western white pine

Boyd (1969) reported on several long-term studies dealing with natural regeneration in the western white pine type. He stratified the old sample plots by the two habitat types represented. Natural regeneration rates and species dominance were clearly different between these two habitat types.

If he had reported these results as representative of the western white pine type, it would have been misleading, because western white pine grows on nine different habitat types in northern Idaho (Daubenmire and Daubenmire 1968). Therefore, caution is necessary in attempting to apply these results to the other seven habitat types.

Current studies on regeneration and stand development in the western white pine - grand fir - western hemlock - western red cedar eco-systems are tied to habitat types in both sampling design and analysis procedures. Without such an ecological stratification, average values for a timber type have often been used that may or may not be applicable to specific sites. A forester needs something more specific, such as habitat types, for extrapolating useful information.

Interior Douglas-fir

The use of potential vegetation classification is also illustrated by results derived from a regeneration survey of interior Douglas-fir in the Northern Rocky Mountains (Ryker 1975). Quoting from the abstract, "Results indicated that the effects of various regeneration methods and the success expected depend largely upon habitat type. Thus, attempts to generalize about seedbed, shade and other species requirements can be misleading."

Establishment of natural Douglas-fir seedlings was greatest in the western hemlock series. Douglas-fir plantation success on the western hemlock and western red cedar habitat types was about double that of warmer and drier habitats. Low survival on clearcuts in the Douglas-fir series indicates that a shelterwood system, a group-selection system or special regeneration techniques may be necessary to successfully regenerate Douglas-fir where it functions as the potential climax species. A later study (Kittams and Ryker 1975) illustrated that the effects of site preparation upon survival and growth also differed between habitat types.

Ponderosa pine

Ponderosa pine, one of the more shade-intolerant species, grows on 11 habitat types (Daubenmire and Daubenmire 1968). The application of cutting methods to these habitat types was discussed by Foiles and Curtis (1973) in relation to regeneration of ponderosa pine in the Northern Rocky Mountain-Intermountain Region. Ponderosa pine is climax on six habitat types representing the warmest and driest sites. Frequently, partial cuttings are used to provide shade for enhancing natural regeneration. Thorough site preparation and planting may be required in openings without overhead shade. On five moister habitat types, ponderosa pine is seral and requires open stands for rapid development of regeneration following establishment. Shearer and Schmidt (1970) provide further natural regeneration information on three Douglas-fir habitat types in western Montana. Even-aged cutting methods favor ponderosa pine on these habitat types; residual trees on partial cuttings should be removed soon after seedling establishment to promote seedling growth.

Western larch

Western larch, the most shade intolerant species in the Northern Rockies, is always seral (Schmidt et al. 1976). It occurs in 13 of 21 habitat types recognized by Daubenmire and Daubenmire (1968) and on 20 of 64 habitat types listed by Pfister and others (1977). Because larch has such a broad ecological amplitude, recommendations for reforesting this species are more meaningful when stratified by habitat type. Seed: seedling ratios for western larch natural regeneration on clearcut and burned areas show a wide range according to habitat type. Moist habitats such as Thuja plicata/Clintonia uniflora have ratios of about 10 seeds per seedling on clearcuts. However, on the harsh sites of south- and west-facing slopes in the Pseudotsuga menziesii/Xerophyllum tenax habitat type, ratios of over 10,000 seeds per seedling are common on clearcuts, pointing out the need of maintaining a seed source that also protects the site until seedlings are established.

Studies of prescribed burning and reforestation in the western larch - Douglas-fir cover type have also demonstrated the extreme variability in germination and survival of several species in relation to habitat type (Shearer 1976). The combined average for all species ranged from 13:1 on the Thuja plicata/Clintonia uniflora habitat type to over 600:1 on the Pseudotsuga menziesii/Xerophyllum tenax habitat type (Table 1). Some variability within habitat type was related to geographic area and aspect.

Table 1. Seed-seedling ratios for total of all species as influenced by aspect and habitat type. (from Shearer 1976)

Aspect	Location	Habitat type	Seed:seedling
North	Newman Ridge	*Thuja plicata/Clintonia uniflora*	13:1
Upper north and east	Miller Creek	*Abies lasiocarpa/Clintonia uniflora—Menziesia ferruginea*	17:1
Northeast to east	Newman Ridge	*Abies grandis/Clintonia uniflora—Clintonia uniflora*	40:1
Lower north, east, and west	Miller Creek	*Abies lasiocarpa/Clintonia uniflora—Clintonia uniflora*	67:1
East and southeast	Newman Ridge	*Abies grandis/Xerophyllum tenax*	92:1
West	Newman Ridge	*Abies grandis/Xerophyllum tenax*	149:1
South	Newman Ridge	*Pseudotsuga menziesii/Xerophyllum tenax*	185:1
South—rapid revegetation	Newman Ridge	*Pseudotsuga menziesii/Xerophyllum tenax*	659:1
West—poorly burned	Newman Ridge	*Pseudotsuga menziesii/Xerophyllum tenax*	668:1

Engelmann spruce

Clearcutting by groups, patches or strips has been generally recommended for harvesting over-mature spruce stands followed by natural regeneration or planting to establish the next stand (Roe, Alexander and Andrews 1970). Although these techniques have proven successful for a major portion of the Engelmann spruce type, their use often resulted in natural regeneration failures on the high plateaus of southern Utah.

In southern Utah, Engelmann spruce stands grow on the three habitat types shown in Figure 2. These spruce stands appear to be typically all-aged in structure, having periodic peaks of regeneration following beetle epidemics. This all-aged structure was later confirmed by Hanley and others (1975) in two study areas. The severe environments represented by these habitat types require regeneration techniques that are strikingly different than those required in other areas. General differences among the three habitat types were shown by the major silvicultural considerations in Table 2, and discussed in Pfister (1973).

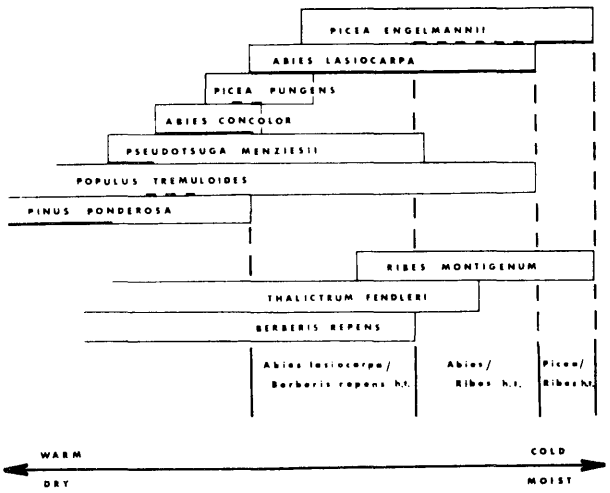

Figure 2. A diagrammatic representation of key species and defined subalpine types for the High Plateaus Section of Utah. The part of the tree species range in which it has the role of a climax species is indicated by the heavy horizontal line. (From Pfister 1972)

Table 2. Silvicultural considerations for the subalpine forests of southern Utah by habitat types

Habitat type	Environment	Species occurrence	Recommended silvicultural systems
Picea/Ribes	Severe	Engelmann spruce	Selection
Abies/Ribes	Severe	Engelmann spruce Subalpine fir Aspen	Selection Shelterwood
Abies/Berberis	Moderate	Engelmann spruce Subalpine fir Douglas-fir Aspen	Selection Shelterwood Clearcut and Plant

A detailed regeneration study (manuscript in preparation) in southern Utah clearcuts showed extremely low germination and survival for sown Engelmann spruce seed as well as poor plantation survival. Success was considerably better on the Abies/Berberis habitat type than on the Abies/Ribes habitat type.

A cooperative R4-INT spruce cutting methods study is currently being measured for 10-year stand development. The five-year remeasurement indicated extreme variability in amounts of natural regeneration (Personal comm., Wyman Schmidt, For. Sci. Lab., Bozeman, Montana). Habitat types reflected both geographic variability as well as local variability within a given geographic area (Table 3). As this is completed, comparisons can be made to spruce regeneration data on a Tsuga/Menziesia habitat type in northern Idaho (Boyd and Deitschman, 1969) and several other studies in the spruce-fir type.

Table 3. Average number of seedlings per acre in the Region Four spruce cutting methods study

Area (National Forest)	Habitat Type	Seedlings (No./acre)
Southern Utah (Dixie N.F.)	Abies lasiocarpa/Ribes montigenum	420
Northern Utah (Uinta N.F.)	" /Berberis repens	540
Western Wyoming (Teton N.F.)	" /Vaccinium globulare	4120
	" /Vaccinium-Senecio	3960
	" /Senecio triangularis	5120
Central Idaho (Payette N.F.)	" /Xerophyllum tenax(very dry)	1000
	" /Xerophyllum-Calamagrostis	2040
	" /Calamagrostis-Vaccinium	4420
	" /Calamagrostis canadensis (very wet)	240

REFORESTATION KNOWLEDGE BY POTENTIAL VEGETATION TYPES

Included in the basic classifications

Recent publications on habitat types usually carry a section on management implications for each of the types that includes a general discussion of regeneration. Similar approaches have been used in several areas. For examples, see:

Hall (1973) Eastern Oregon Community Types

Pfister and others (1977) Montana Forest Habitat Types

Hoffman and Alexander (1976) Forest Vegetation of Bighorn Mountains

Forthcoming publications in Arizona, New Mexico, Washington, Oregon, Utah, Idaho, Wyoming and Colorado will also likely have similar sections on management implications related to regeneration.

Developed after the classifications

Earlier classifications often do not have special sections interpreting the habitat types for managers. Specialists then have the opportunity to develop interpretations following field experience using the classification. In 1971, management specialists in the Northern Region collaborated on a summary of management implications for the Daubenmires' (1968) habitat type classification (Pfister and others 1971). These specialists had a thorough familiarity with both the classification system and recognized expertise in their own specialty. The species preference table (Table 4) and silvicultural implications table (Table 5) were developed as general summaries. Individual National Forests were encouraged to develop similar summaries based on local experience.

Currently, we are summarizing some regeneration knowledge for northern Idaho and Montana; examples are shown for natural regeneration (or fall direct seeding) of Engelmann spruce (Table 6) and western larch (Table 7). The first step was to review the results of several regeneration studies in relation to habitat types. These results were then interpreted according to broad probabilities of regeneration success. From this benchmark data, we used the ecological knowledge of the vegetation classification and our observations to place habitat types and phases in the most appropriate probability classes. These represent our best current estimates of relative probabilities. They can serve as (1) hypotheses for further testing and (2) as interim guidelines for managers. Of course, they are subject to revision as our data base and knowledge increase.

Table 4--SPECIES PREFERENCE BY DAUBENMIRE HABITAT TYPES
(Parentheses indicate presence in certain areas of the type.)
(from Pfister and others 1971)

HABITAT TYPE	DESIRABLE SPECIES	ACCEPTABLE SPECIES
PP/Needlgrass	PP	
PP/Wheatgrass	PP	
PP/Fescue	PP	
PP/Bitterbrush	PP	
PP/Snowberry	PP	
PP/Ninebark	PP	
DF/Snowberry	PP, DF, (L)	(LP)
DF/Pinegrass	(L), DF, LP, (PP)	
DF/Ninebark	PP, DF, (L)	(LP)
GF/Pachistima	PP, GF, L, DF, WP, (ES)	LP1/
C/Pachistima	WP, C, L, DF, GF, (PP)	LP1/, ES
WH/Pachistima	WP, GF, ES, C, H, L3/, DF2/	LP1/
C/Ladyfern	C, ES	DF, GF, WP
C/Devilsclub	WP, C, ES, WH, L3/	LP, GF, DF
AF/Pachistima	L, ES, DF, LP1/, WP	AF, GF
AF/Beargrass	(L), (LP), (DF)	(WP), (ES), AF
MH/Beargrass	(Insufficient Data)	
AF/Menziesia	ES, (L), (DF), AF, (WP), (LP)	
MH/Menziesia	(L), (LP), ES, AF	MH
AF/Whortleberry	LP	ES, AF, (L)
AF/WBP	Non-commercial h.t.	

Blister rust resistant stock is assumed for the white pine shown in the table.

The footnotes list limitations that are strongly related to habitat type.

1/ Should be managed on a shorter rotation because of the mountain pine beetle.

2/ Should be managed on a shorter rotation because of Poria weirii.

3/ Should be managed on a shorter rotation because of Fomes pini.

Table 5-SILVICULTURAL IMPLICATIONS OF HABITAT TYPES (from Pfister and others 1971)

Habitat Type		(1)	(2)	(3) Site Preparation	(4)	(5)	(6)	(7)
Climax Tree Species	Undergrowth Union	Harvest Cutting Methods 1/	D.-Fir Survival %	Scarification 3/ (years)	Burning 4/	Probability of Natural Regeneration Success 5/ w/o slash disposal or site prep.	w/scar	w/burning
PP	Needlegrass	S SW				Low	L-M	Low
PP	Wheatgrass	S SW				Low	L-M	Low
PP	Idaho fescue	S SW				Low	L-M	Low
PP	Bitterbrush	S SW				Med	Med	Med
PP	Snowberry	S SW				Low	L-M	L-M
PP	Ninebark	S SW				Low	Med	Med
DF	Snowberry	SW CC	7	3	2	Low	Med	L-M
DF	Pinegrass	SW CC	22	2	0-1	Low	Med	Low
DF	" -Kinik.	SW CC		2	0-1	Low	Med	Low
DF	Ninebark	SW CC	12	3	2	Low	Med	Med
GF	Pachistima	SW CC	14	3	2	Med	Med-H	Med-H
WRC	Pachistima	SW CC	32	2	2	High	High	High
WH	Pachistima	SW CC	37	2	2	High	High	High
WRC	Ladyfern	S				Med	High	Med
WRC	Devils club	S CC				Med	High	Med
AF	Pachistima	SW CC	27	3	3	High	High	High
AF	Beargrass	S SW CC	32	6	2	Low	Med	L-M
MH	Beargrass	S SW CC	17	6	2	Low	Med	L-M
AF	Menziesia	(SW)CC	43	5	3	Low	High	Med
MH	Menziesia	(SW)CC		5	3	Low	High	Med
AF	Vaccinium	CC		5	3	Med	High	High
AF-WBB								

1/ Recommended possible cutting methods based on silvicultural consideration where timber production is a major objective. S=Selection SW=Shelterwood CC=Clearcut (Group selection and seed trees can be considered as variants of these three general methods.)

2/ Data from R. Rykers recent Douglas-fir regeneration survey expressed as % mil-acre stocking of Douglas-fir in Douglas-fir plantations. (To be published on an INT Station Paper)

3/ Scarification refers to preparation of a strip or large scalp deep enough to remove most resprouting organs of competing vegetation and is expressed as average years longevity of site preparation benefits.

4/ Burning refers generally to broadcast burning of normal, medium to light intensity, and is expressed as average years longevity of site preparation benefits.

5/ Because of climatic and seed crop variability from year to year, probabilities are very general and simply relative ratings. Additional data is needed to express this in quantitative probability terms.

Table 6. Expected probability of successful natural regeneration of Engelmann spruce by habitat types and phases

Series	Location[1]	Expected Probability of Success		
		High	Moderate	Low
Picea	Montana	Eqar; Gatr; Clun-clun	Clun-vaca; Libo; Smst	Vaca; Phma
Abies grandis	Montana	Clun-Arnu	Clun-clun; Clun-xete;	
	N. Idaho		Pamy	
Thuja plicata	Montana		Clun[2]; Opho	
	N.Idaho		Pamy; Opho; Atfi	
Tsuga neterophylla	Montana		Clun[2]	
	N. Idaho		Pamy	
Abies lasiocarpa	Montana	Opho; Gatr; Caca-caca; Caca-gatr; Clun-clun;[3] Clun-mefe [3]	Clun-vaca;[3] Clun-xete [3] Clun-arnu[3] Caca-vaca; Mefe; Vagl; Libo[2]; Vasc-thoc;	Vaca; Xete[2] Caru; Vasc-caru; Vasc-vasc; Luhi[2]
	N. Idaho	Pamy	Mefe[3]	Xete
Tsuga mertensiana	Montana	Mefe[3]	Xete	
	N. Idaho	Mefe[3]	Xete	

[1] Montana (Pfister et al. 1977); N. Idaho (Daubenmires 1968)

[2] Includes all phases

[3] Regeneration plots on these habitat types

Table 7. Expected probability of successful natural regeneration of western larch by habitat types and phases

Series	Location[1]	Expected probability of success		
		High	Moderate	Low
Pseudotsuga menziesii	Montana		Vaca; Libo[2]	Phma-phma; Caru-aruv; Caru-cari; Vagl-xete[3] Vagl-vagl; Vagl-aruv
	N. Idaho			Phma; Caru[2]; Syal
Picea	Montana	Clun-clun	Clun-vaca; Vaca	
Abies grandis	Montana	Clun[3]	Xete[3]	
	N. Idaho	Pamy		
Thuja plicata	Montana	Clun[2/3]		
	N. Idaho	Pamy		
Tsuga heterophylla	Montana	Clun[2]		
	N. Idaho	Pamy		
Abies lasiocarpa	Montana	Clun-clun[3]; Clun-mete[3]	Clun-xete[3] Clun-vaca; Libo[2]; Mete	Opho; Xete[1]
	N. Idaho	Pamy	Mete	Xete
Tsuga mertensiana	Montana	Mefe[3]	Xete	
	N. Idaho	Mefe[3]		

1/ Montana (Pfister et al. 1977); N. Idaho (Daubenmire & Daubenmire 1968)

2/ Includes all phases

3/ Plots on these habitat types

APPLICATION OF EXISTING KNOWLEDGE

Reforestation opportunities and problems can be clarified by using habitat types. Once a manager knows the habitat type and existing species composition, he can utilize species preference guides to help make an ecologically sound selection of species to favor in management. Silvicultural prescriptions can then be written to meet the silvicultural requirements of the desired species for a given set of site conditions on a specific environment (identified by habitat type).

Habitat types also indicate severity of site and vegetative competition--two of the major factors limiting regeneration success. Thus, they also influence the choice of regeneration methods and the degree of site preparation. Warm, dry sites (e.g., Pseudotsuga series) require a greater reduction of plant competition and a greater amount of shade. Sites with grass-dominated undergrowth (e.g., Pseudotsuga/Calamagrostis rubescens h. t.) require a hot burn or dozer scarification to substantially reduce the graminoid competition. The amount of site preparation and amount of seed (or planting stock) can also be adjusted in relation to the expected probabilities of regeneration success.

The amount of data available to assist the manager in making these decisions is increasing through research and administrative studies. However, observations and intuition will still be used extensively to prescribe regeneration practices. It is important that we make full use of available tools in our silvicultural practices, as well as developing new knowledge.

OPPORTUNITIES TO DEVELOP NEW KNOWLEDGE

The utility of potential vegetation classifications for silviculture is generally acknowledged in the western United States. Several of the excellent "state-of-the-art" silvicultural summaries for the Rocky Mountain cover types conclude with recommendations emphasizing the need for habitat type classifications as a foundation for future silvicultural research. Where classifications have been completed for some time, they have worn well. New classifications are implemented rapidly, especially when they are presented through a training program. Nevertheless, they are not an end in themselves. The classifications must be used and interpreted before management implication potentials can be fully realized. There are several opportunities to improve regeneration practices by summarizing existing knowledge and developing new knowledge.

Completion of potential vegetation classifications

Formal completed classifications are needed to utilize knowledge of potential vegetation. The classifications provide the basic ecological foundation and enable accurate communication and accumulation of knowledge from specific sites for designated application. The classification work is generally considered as research because interactions of species and environments must be worked out for each new area. However, since techniques are becoming more standardized, and some extrapolation can be carried from adjacent areas, certain aspects of the studies can be considered in the realm of administrative studies. Regardless of the debates on research vs. administrative studies, the most fruitful studies will be those that are conducted on a cooperative basis in the philosophy of research, development and application as an integral package. Many areas in the western United States now have formal classifications (Figure 1). However, continued emphasis will be needed during the next decade to get remaining areas completed.

State of knowledge summaries

In most areas there are numerous individuals who know a great deal about the species and sites they have worked closely with over a period of years. However, each individual's knowledge is limited to the scope of his experience. How can this individual knowledge be brought together in one central framework, summarized and made available to all practitioners? A teamwork approach is obviously desirable, but how do you organize the team?

If the subject or problem area is kept narrow enough in scope, a workshop approach may be the most efficient method to accumulate the information. The objectives of the workshop and the procedures to gather and evaluate the information must be clearly specified by a coordinator or small coordinating group. The form of summaries needed by managers must be clearly specified to keep on track. Research involvement is essential to provide some behchmark data points and to maximize objectivity in evaluation of the input. Once the knowledge on a given subject is accumulated, it must be formally documented and subjected to review of original participants and other selected specialists. If done properly, the workshop results should serve as adequate interim guides for management and as good hypotheses for research testing in areas of weakest data and greatest needs.

In most cases, the workshop results should be formally published in a publication outlet such as a Station Research Note. This is referenceable for current use, but also easy to replace with an improved version at a later date. With a solid document to start from, the same format can be used to develop local guides that are simpler in numbers of types, but more specific in terms of local conditions.

If the subject area-problem area is very broad or includes a number of closely-related problems, the workshop approach may be too cumbersome. A smaller team could then be organized to work closely for a longer period of time. Team members must have a dual familiarity with the specific subject area and the ecological classification being used as a framework to summarize the knowledge.

New research studies

Ideally, we would have a solid research data base for all tree species growing on all sites. Then a manager could just specify the tree species and the site and look up the exact information needed. Unfortunately, research is generally very site intensive and a little data must be stretched a long way. We must make sure that (1) results are applied to appropriate conditions and (2) they aren't stretched too far.

Current field studies need to be stratified by habitat types (e.g., Sinclair and Boyd 1973) so the results can be extrapolated to appropriate sites. Older studies can often be re-evaluated when a classification becomes available. Ecological stratification helps the researcher avoid trying to solve the world problem with a single study and allows the manager to evaluate which results are appropriate to the problem at hand. The same philosophy can be applied to the conduct of administrative studies.

Accumulating records of treatments

A basic lesson of history is that--he who ignores the mistakes of the past is doomed to repeat them. The greatest value of regeneration failures should be to help us learn how to do a better job on the next one. We learn by experience, but how well we learn is strongly dependent on the kinds of records we keep. In silviculture, success or failure is often not obvious for several years. George lives with Joe's failures, Sam lives with George's failures, etc. Sadly, however, none of them learned anything in the process unless their predecessor left enough records to help explain the reasons for the failures.

We have enough computers to accumulate and store all the records we could ever want (perhaps more than we could want!). However, the success of a record-keeping system is especially dependent on the quality control of the data going in.

Good records of treatments, stand conditions and sites would be a foundation for future analyses and state of knowledge summaries. In the field of regeneration surveys, quality control is especially crucial. If relationships to potential vegetation classifications are desired, special attention is required to ensure accurate identification of habitat type. This requires qualified people with professional backgrounds who are trained in the working details of using a classification and are

diligently supervised to ensure maintenance of quality control. Most school teachers and liberal arts majors don't have the necessary background. (Neither do some foresters, but that's another problem.)

SUMMARY AND CONCLUSIONS

1. Based on our experience in the Rocky Mountains, we see potential vegetation classification as an extremely valuable tool for silviculture--especially in the field of regeneration.

2. From a general viewpoint, successful implementation of Section 4 of the 1976 National Forest Management Act will be aided by potential vegetation classification.

3. Habitat type classifications are now available and being used in a large portion of the western United States. They provide both (1) a classification of potential natural vegetation, and (2) an ecological site classification tool.

4. Species and cover types extend over a wide range of sites. General knowledge of species requirements and responses to management is becoming more specific by considering site variations within a standardized ecological framework.

5. Management implications by habitat types are aimed at summarizing knowledge by sites (in contrast to species or cover types). This approach is directly related to those kinds of management problems that are best expressed in terms of sites or areas of land.

6. Application of existing knowledge to appropriate sites is always a problem. Use of ecological classification provides a framework for proper extrapolation.

7. New research is needed for many problem areas, but some problems can be solved by analysis of existing data and summarizing current knowledge in an appropriate format. Many opportunities exist for closer cooperation between researchers and managers.

8. Although the examples and emphasis in this presentation were generally restricted to the northern Rocky Mountains, the general principles and concepts are generally applicable to many other areas. Ecological classification can be very useful for improving regeneration practices.

Epilogue

by Bob Pfister

During the first day of this workshop, it became apparent that Section 4 of the NFM Act could be interpreted narrowly or broadly. The proceeding discussion was aimed at regeneration where timber production was assumed to be the primary objective.

On the other hand, a much broader interpretation is also conceivable. The narrow perspective probably includes only less than half of the total "forest land" area in the western United States. The broader perspective, including all "forest land," also inters regeneration as a key concern on lands other than CFL. Potential vegetation classification also provides a useful tool for obtaining and maintaining "appropriate forest cover" on these lands.

The professional recognition of silviculturists and the importance of sound silvicultural prescriptions for manipulation of all forest vegetation have come a long way in the last decade. The NFMA provides new thrust and emphasis to the role of the silviculturist in multiple use management. A leadership role is available---other functions are dependent---silviculture is more than timber production. Will silviculturists accept the challenge?

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Presented by Andrew A. Leven

THE USE OF SOIL INFORMATION IN EVALUATING REFORESTATION POTENTIAL

There are certain soil factors that can influence the degree of success of our reforestation efforts. This paper will discuss some of the more important ones by presenting a method used by one of the Forests in Region 5. It is a multi-disciplinary look at getting on top of the reforestation backlog that existed on the Shasta-Trinity National Forest. It is multi-disciplinary in that the Forest Silviculturist and Forest Soil Scientists worked together to develop the inventory and evaluation process. The system recognizes and uses two types of data: vegetative and edaphic. Vegetative response and interactions reflect the site potential and production within the ecosystem. Edaphic conditions identify the major limiting factors of the ecosystem and set the stage for determining the management alternatives. There are five major uses for the system:

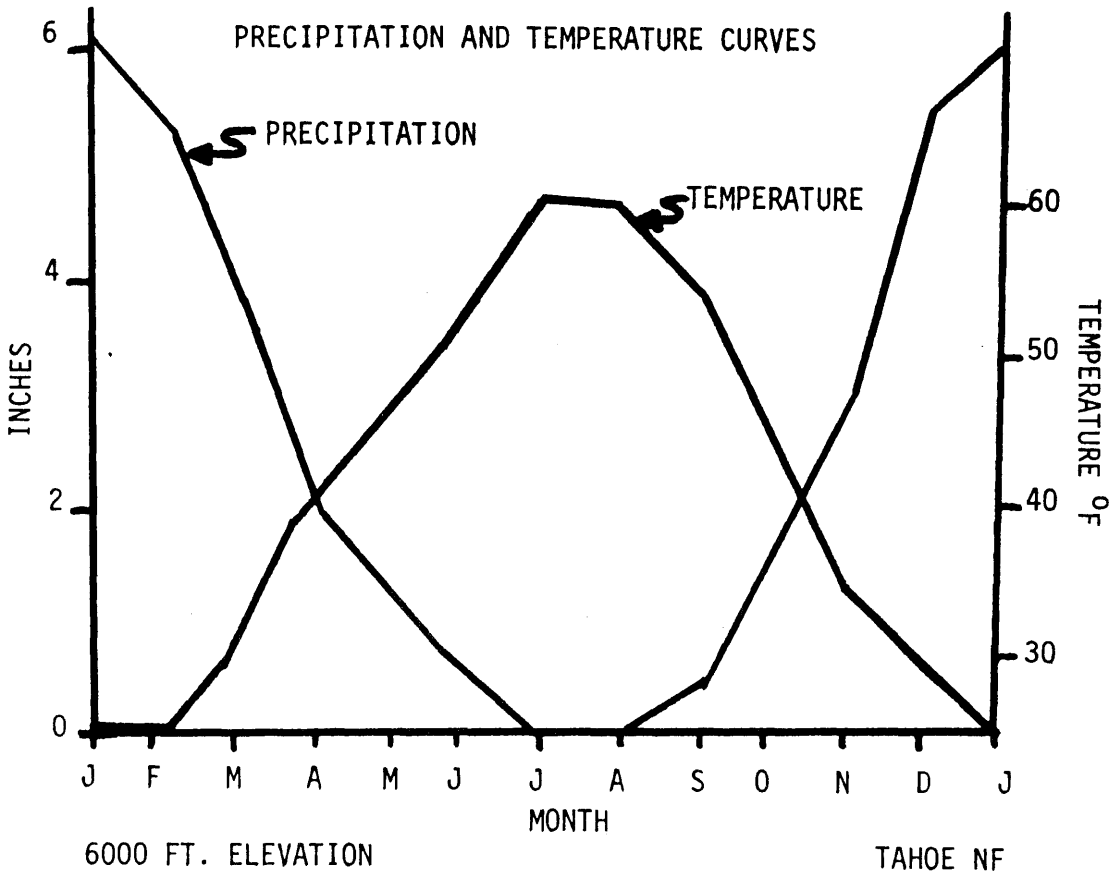
1. Predict the potential first-year seedling survival;
2. Evaluate stocking levels;
3. Classify land within the Timberland Classification System;
4. Priority rank land areas; and
5. Develop management alternatives to mitigate identified limitations for reforestation.

As the title indicates, this paper's contents present a little overkill on the soils related portion of the system.

When taking a look at soils, it is desirable to identify the soil factors most critical to the success of growing trees. In the California Region, as well as in some other Western States, moisture is the critical or limiting natural factor. Of course, there are some other factors that govern tree growth, one of which is plant nutrient levels, but moisture is by far the most important factor. Nutrient levels can be changed but usually moisture cannot be added because of the lack of it or economic limitations. What makes moisture limiting in California? One of the main factors is seasonal distribution of precipitation. The climate is Mediterranean; that is, all the rain comes from October to April. The summers are long with very little or no precipitation. So, for vegetation to get all the moisture it needs, it must be able to grow during the rainy season. Unfortunately, October through April temperatures are generally too low for growth. (See Figure 1). Therefore, plants must extract water that is stored in the soil during periods of time when temperatures are conducive to growth if they are to survive. Thus, soil moisture storage becomes an important consideration.

Presented at the National Silviculture Workshop, September, 1977, Flagstaff, Arizona by Andrew A. Leven, Director, Watershed Management Staff, California Region.

FIGURE 1


PRECIPITATION AND TEMPERATURE CURVES
PRECIPITATION
TEMPERATURE
INCHES
TEMPERATURE °F
6
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J F M A M J J A S O N D J
MONTH
6000 FT. ELEVATION
TAHOE NF

Moisture stored in the soil is critical to tree growth and is critical to successful site reforestation. Soil moisture storage is governed by soil depth, texture (including rockiness) and density. Depth and texture are generally the most important soil factors to evaluate, but density is important in some instances as I will discuss later. It is fairly obvious that depth is important--simply because the deeper the soil the greater is its volume. (See Figure 2). What controls the ability of a soil of a given depth to store water? Texture is the primary factor. Of course drainage also is very important, but most of our forested soils in California are well drained. Texture not only influences the total volume of moisture a soil can hold but more important it governs the amount of moisture a plant can extract from the soil. (See Figure 3). A loam textured soil provides about the most ideal moisture availability. For example, using a cubic foot of soil, a sand textured soil holds 1.0 inches of plant available moisture, a loam holds 2.2 inches of plant available moisture, and a clay holds 1.8 inches of plant available moisture.

Another item that reduces a soil's capacity to store moisture is coarse fragments, such as gravel, cobble, stone, rock, etc. In general, the amount of soil moisture storage lost is equivalent to the volume occupied by coarse fragments. In other words, a loam-textured soil that is 50 percent stone has lost roughly half its capacity to store moisture. (See Figure 3a).

Texture also affects infiltration and permeability rates. Generally the finer the texture, the slower the infiltration and permeability. However, this is not critical in forested areas of California because most of the moisture enters the soil as snowmelt.

These are the main soil factors that influence the soil's ability to hold and supply plant moisture. Evapotranspiration is one of the prime influences on how long that soil moisture is available for plants to use. What are the effects of evapo-transpiration (ET) loss of soil moisture on forest soils in California? Some obvious relationships are:

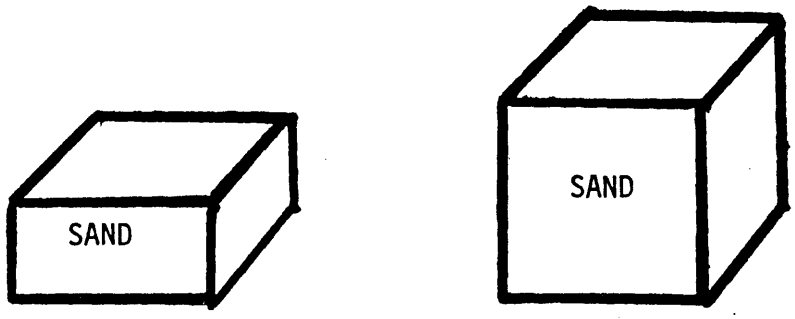
1. It takes less time for ET to remove moisture from a sand than a loam textured soil because there is less moisture to begin with. Thus, a loam textured soil will provide more days of plant available moisture than a sandy soil.

2. To some degree, ET is a function of temperature; the hotter the temperature, the higher the ET. Thus, soils on hot sites will have their moisture depleted at a faster rate than soils on cool sites.

3. Aspect and slope have an influence on how much solar radiation a site receives. A south slope receives more solar radiation than a north slope; thus south slopes are warmer. Warmer sites have higher ET, dry out faster compared to cool sites, and moisture stress is earlier in the season. (See figure 4 & 5).

FIGURE- 2

MORE SOIL DEPTH = MORE VOLUME FOR HOLDING WATER

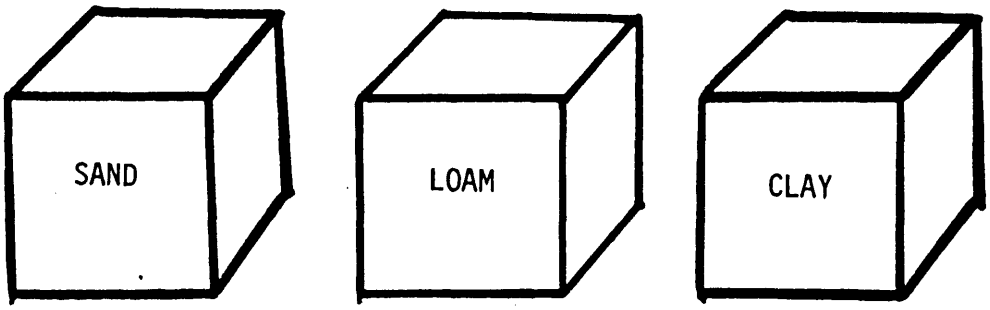


PAW = 0.5 IN. PAW = 1.0 IN.

PAW = PLANT AVAILABLE WATER

FIGURE 3

SOIL MOISTURE STORAGE RELATIONSHIPS



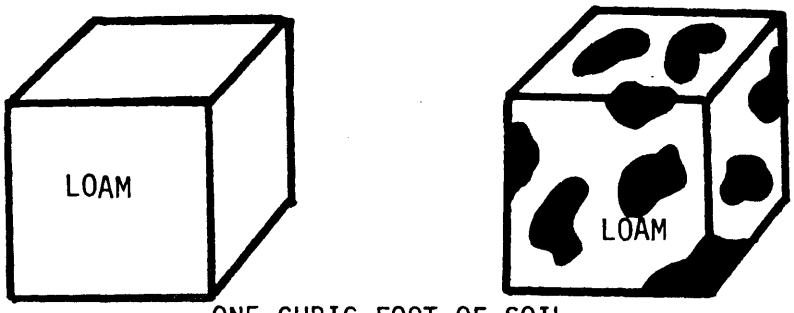
ONE CUBIC FOOT OF SOIL

PAW = 1.0 IN. PAW = 2.2 IN. PAW = 1.8 IN.

PAW = PLANT AVAILABLE WATER

FIGURE 3a

EFFECT OF COARSE FRAGMENT
CONTENT ON SOIL MOISTURE STORAGE



ONE CUBIC FOOT OF SOIL

% STONE = 0
PAW = 2.2 IN.

% STONE = 50
PAW = 1.1 IN.

PAW = PLANT AVAILABLE WATER

FIGURE 4

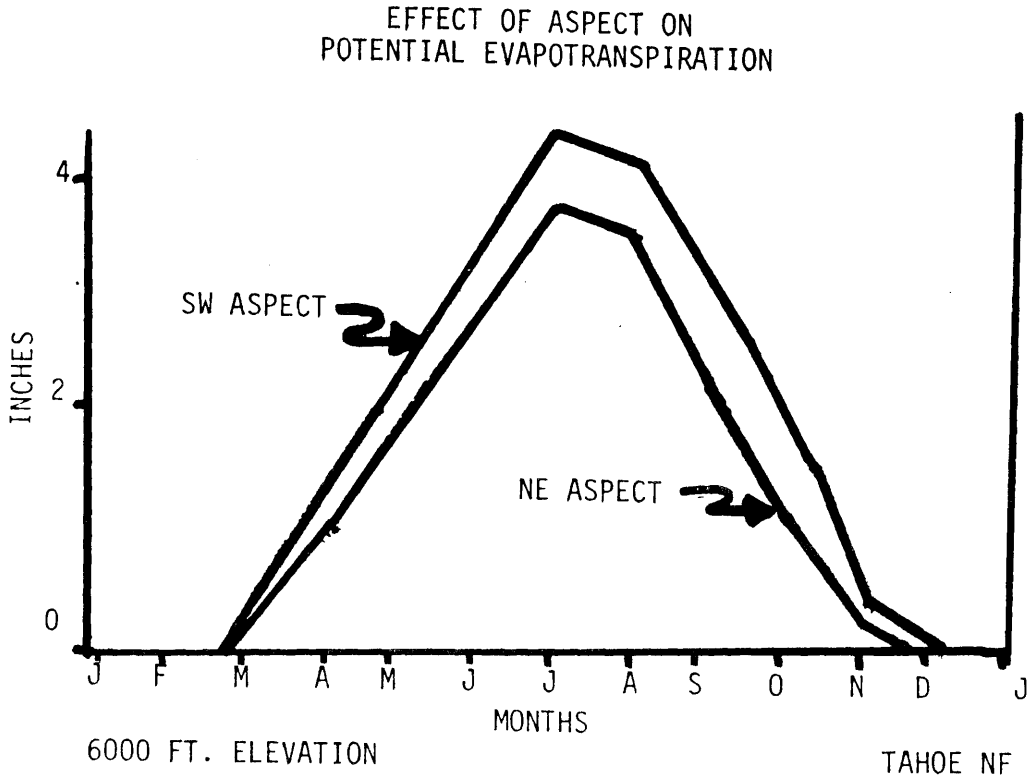
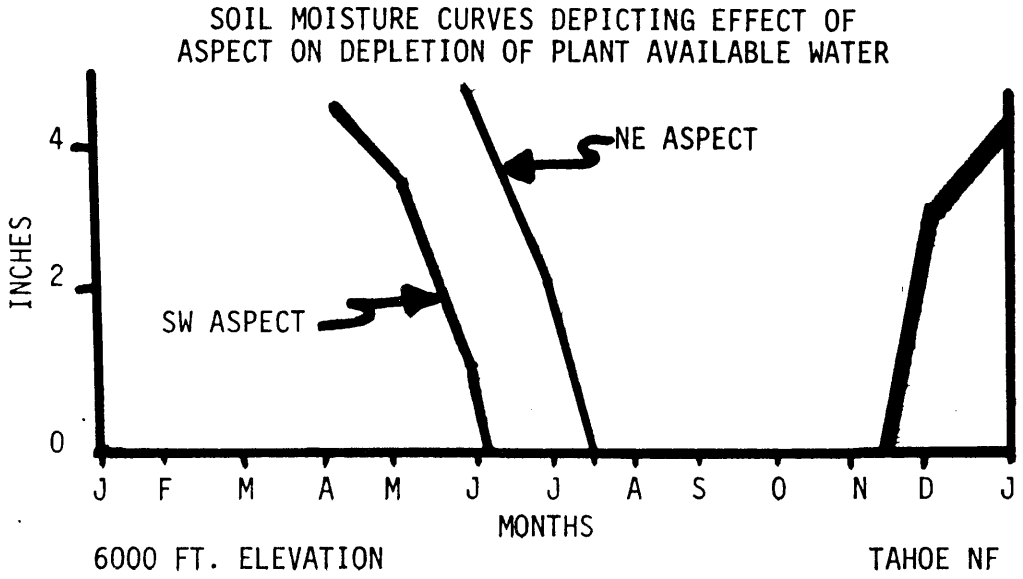

EFFECT OF ASPECT ON
POTENTIAL EVAPOTRANSPIRATION
4
2
0
INCHES
SW ASPECT
NE ASPECT
J F M A M J J A S O N D J
MONTHS
6000 FT. ELEVATION
TAHOE NF

FIGURE 5


SOIL MOISTURE CURVES DEPICTING EFFECT OF
ASPECT ON DEPLETION OF PLANT AVAILABLE WATER
NE ASPECT
SW ASPECT
INCHES
4
2
0
J F M A M J J A S O N D J
MONTHS
6000 FT. ELEVATION
TAHOE NF

Another soil property that is important in the evaluation of reforestation is the depth of the surface soil or A horizon. Researchers have noted that the upper layers of forest soils contain the major portion of the nutrients available for plant use. This is because most of the forested-mountainous soils in California have poorly developed soil profiles. The majority of the plant nutrients are held in the organic matter fraction that occurs in the upper few inches of the soil profile. Thus, the depth or thickness of this layer is important; this is especially true when considering things that contribute to the potential success of reforestation efforts. If a surface organic matter-soil horizon is absent or removed, plant nutrients available to seedlings will be low.

While considering availability of plant nutrients, how does availability effect reforestation success? Nutrients have less effect on reforestation than does moisture unless one of the major nutrients of nitrogen, phosphorus or potassium is totally absent from the soil. Or if one of the minor nutrients supply is extremely out of balance with other elements, this may cause a nonavailability of one or more of the other elements causing reduced plant growth. In general, if moisture is available, there are usually sufficient nutrients for some seedling survival. However, rate of growth and survival rates can be increased by insuring the proper amount and balance of nutrients.

Back to the inventory and evaluation process introduced earlier. Following is the step process used:

1. Using aerial photos, stereoscopically delineate non-stocked areas. Mark transects through representative portions of the delineated areas.

2. Field Procedures:

   a. Check soils for homogeneity - Make additional delineations if required. Describe the soil profile characteristics.

   b. Determine commercial quality of the site. Land not capable of producing 20 cubic feet of wood per year per acre is considered as noncommercial.

      This is determined thusly:

      (1) Less than 20 inches of soil to bedrock and precipitation less than 20 inches/year

      (2) Available water holding capacity (AWC) is less than 1.8 inches in the top 24 inches or less than 3 inches in the total profile, and aspect-temp. factor is 4, or

      (3) AWC is less than 2.5 inches in the top 24 inches or less than 4 inches in the total profile, and an aspect-temp. factor is 5.

CALCULATION OF ASPECT-TEMPERATURE FACTOR

NW-NE (315°-45°) 1	(270°-315°) NE-SE (45°-135°) 2	W-SE (270°-135°) 3
6,000'-5,000' Frigid 1		6,000' Cryic 3
5,000'-4,000' Mesic 0	4,000'-3,000' Mesic 1	3,000'-2,000' Mesic 2

TOTAL_____

Should a site be determined non-stockable or non-commercial, the surveyor need only complete the soils data sheet. No plots are needed.

These values were determined in a combination of ways. Numerous restoration sites were field checked to determine survival rates. Information was gathered about available water holding capacity of the site, elevation, aspect, site class and an estimation of the reason for success or failure of reforestation projects. The results were stratified so that further analysis could be made of sites that were success or failure and site productivity could reasonably be attributed to soil moisture storage conditions. Numerous soil moisture regimes were determined to evaluate water use, evapotranspiration and site productivity relationships. About the same time, one of the Region's soil scientists completed a Master of Science with the dissertation being on soil conditions related to tree growth and reforestation; so that information was also used. The end result was simplified rating system shown above.

c. Collect vegetation information and determine site index potential. This is done by measuring trees at the site.

If trees were absent, site indicator plant species were used to estimate productivity if that information was available.

If not, site potential was estimated by projecting productivity data from similar soils and sites.

d. Determine stocking of the site by measuring and recording the following: number of trees, height, DBH, damage, crown ratio, and increment boring.

e. Estimate potential for reforestation success.

The criteria established here evaluates the soil and climatic potential of a site for successful reforestation. Many factors other than soils and climate influence the survival of seedlings (McLaughlin, 1974). The tree species, the seed source of the stock, the time of lifting at the nursery, cold storage time, site preparation, and rodent and browse damage all contribute to the success or failure of a replanted site.

Good soil and climatic conditions will not guarantee regeneration success but poor conditions will greatly reduce the chance of success.

Chance of Regeneration Survival, Table 1, presents a means to evaluate the chance of regeneration success for the survival of bare-root stock seedlings the first season after planning.

The ratings for component criteria are placed to the right of the table and summed to give a total at the bottom. The total rating provides an evaluation on a 1 to 4 scale of the Chance of Regeneration Success.

Before any site can be accurately evaluated for regeneration success, the planting stock must be matched to the site. The elevation of the site can indicate what species are adapted to that site's microclimate. Thus the predictions of seedling survival are made assuming ponderosa pine and Douglas-fir seedlings are planted in mesic regimes and true firs are planted in frigid and cryic regimes. Any site deemed to be thermic is automatically excluded from further consideration as a plantation.

The following are generalized criteria used to evaluate temperature regime in lieu of soil temperature measurement.

Isomesic (coastal fog influence) and mesic (most commerical timber sites) - 2,000' to 5,000' elevation. Plant indicator species - black oak.

CHANCE OF REGENERATION SUCCESS

	HIGH	MODERATE	LOW
Available Moisture in the Top 24"	≥3.2" 3	3.2"-2.0" 6	≤2.0" 12
Anticipated Competition	None to Low (Complete Site Prep.) 0		High (No Site Prep.) 3
Fertility (Presence of A Horizon	A horizon present 0		A horizon absent 6

_____ TOTAL

AND

Aspect (Temp. & Evapotrans.)	NW to NE 315° to 45° 1	NE to SE 46° to 135° W to NW 270° - 314° 2	SE to W 136° to 269° 3
Elevation (Temp. & Evapotrans.)	6000'-5000' Frigid 0		>6000' Cryic 3
	5000'-4000' Mesic 0	4000'-3000' Mesic 1	3000'-2000' Mesic 2

_____ TOTAL

Regeneration Chance Survival Rating	% Survival	Total
1	100-80	4-8
2	79-60	9-13
3	59-40	14-17
4	40	18-22

Frigid - 5,000' elevation. Plant indicator species - red fir and possibly sure stand of white fir.

Cryic - 6,000' elevation. Plant indicator species - lodgepole pine, red fir, mountain hemlock.

Thermic - Plant indicator species - digger pine, interior live oak, annual grasses, usually < 2,000' elevation. Any thermic sites can be automatically eliminated from further consideration.

Aspect may modify the criteria listed above to the extent that a mesic elevation site on a north aspect may be thermic on the hotter, south aspect. Cold air drainage conditions should also be considered as well as exposure.

Discussion of Criteria for Chance of Regeneration Success

AWC In the Top 24" - McLaughlin (McLaughlin, 1974) has cited reference stating that seedlings can extend roots to 21" in the first growing season; thus the plant available moisture should be evaluated to this depth.

Anticipated Competition - In making seedling survival predictions it is reasonable to assume total site preparation and satisfactory follow-up to keep brush competition to a minimum. Should anything less than this type of site preparation be considered, an adjustment in the survival chance must be made.

Fertility - The depth of the A horizon will be used as a measure of soil fertility. The A horizon is defined here as the horizon of maximum organic matter accumulation. Organic matter manifests itself as lower values and chromas of color and in crumb and granular aggregation of the surface soil horizon as opposed to loose or massive structure.

Aspect (Soil Temperature) - Soil temperature is important to survival in two ways:

(1) High temperatures may cause direct damage to plants. This type of damage seems to be limited to sites replanted by seeding. Bare root stock seedlings seem to be resistant to severe heat damage (Gilbert, Schubert, and Adams, Reforestation Practices in California, 1971, California Division of Forestry), and

(2) High temperatures increase evapotranspiration, causing moisture stress earlier in the season. This last effect is evaluated in the criteria table. Aspect is very important in making this evaluation. Nash, 1963, evaluates various aspects and slopes and their effect upon soil water balance. Figure 6 shows Nash's diagram representing solar

radiation receipt of a 40% slope in May, corrected for average cloudiness, as percent south radiation. Figure 7 is Figure 6 corrected for ambient air temperature effects on evapotranspiration rates. Values given are the rating used in criteria Table 1.

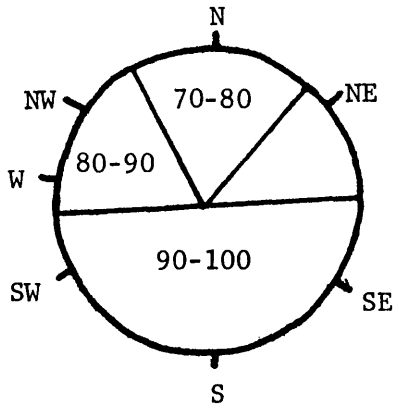


Figure 6

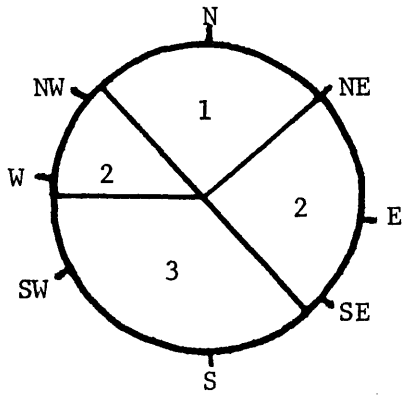


Figure 7

Elevation - Within the Mesic elevation range (temperature regime) there is an improvement in site success with increasing elevation. Thus the 2,000' to 5,000' mesic range is divided into 1,000' increments and rated accordingly. Likewise, cryic regimes are less favorable for fir plantations than frigid regimes.

f. The sites were next classified as: unproductive land, non-stocked commercial forest land, stocked commercial forest land, standard component, special component, marginal component, unstable landscape, marginal plantability.

g. The sites were priority ranked for reforestation and timber stand improvement using the reforestation success potential rating, site potential, and slope.

3. Management Practices

It was noted earlier that one of the uses for this information was in the development of management alternatives to mitigate limitations for reforestation success. Since moisture is important, let's look at ways to maximize the availability of what is present for seedling use. One of the major management practices that is employed is reduction of plant competition. Elimination of unwanted plants makes more water available for

the desirable plants. There are numerous ways of eliminating or suppressing growth of undesirable competition, but they will not be discussed here. The important thing is use of soil moisture storage capacity as one of the factors in priority ranking sites for suppression of plant competition.

Once conditions are favorable for maximum use of available water by seedlings and trees, then you should begin to look at plant nutrient supply. The management practice used in site preparation could influence nutrient supply. It was noted earlier that the majority of the nutrients in mountain soils occur in the surface layers of the soil profile. Scalping and piling of the soil surface in windrows can remove plant nutrients and significantly lower site productivity and reforestation success. Also, if the soils are shallow and the surface is removed, available water storage capacity could be reduced to critical levels. Nutrient levels favorable for tree growth can be provided by adding commercial fertilizer. This can increase survival percentages as shown in the table below.

EFFECT OF FERTILIZER ON SURVIVAL
RATE OF PONDEROSA SEEDLINGS

SURVIVAL (PERCENT)	
NO FERTILIZER	PELLET FERTILIZER 22-8-2
55	69
64	76

ONE YEAR OLD PLANTATION - ONE PELLET/TREE

MC CLOUD ROAD, SHASTA-TRINITY N.F. 1976-77

Addition of fertilizer can also increase growth of trees already established. Recent studies in the Region indicate that growth can be increased by adding nitrogen (in the form of Ammonium Nitrate 33-0-0) to ponderosa pine sites that have less than .8 percent needle nitrogen content. Studies are being conducted to determine the magnitude and length of this response.

In summary, I have presented some information of how soil factors can be used to assist in evaluating reforestation potential. We also discussed a combined soil-timber inventory and analysis procedure that was used by the Shasta-Trinity National Forest to determine soil and vegetation conditions for selecting sites for reforestation. The procedure was used on 140,000 acres. The results were:

50,000 Found suitable but unstocked.
36,000 Stocked but need release and thinning.
54,000 Unproductive - too steep, shallow, etc.

I also briefly spoke about some effects of management practices on reforestation success and tree growth. The main thought that I would like to end with is that by working together in our analysis of reforestation and site potential we can improve our success in the management and production of our National Forest lands.

Presented by Jack Bennett

Cutting Methods in Relation to Resource Use In Central Rocky Mountain Spruce-Fir Forests

Robert R. Alexander

*ABSTRACT—In terms of any of the goods and services usually aimed for under multiple-use management, the spruce-fir type is the largest and most valuable forest resource in the central Rocky Mountains. Engelmann spruce (*Picea engelmannii *Parry), the most desirable timber tree in the type, needs mineral soil seedbeds and partial shade for best establishment and early growth. Spruce can be harvested and regenerated by all silvicultural systems except the seed tree method—subject to limitations imposed by stand conditions.*

Forests of Engelmann spruce and subalpine fir, *Abies lasiocarpa* (Hook.) Nutt. are the largest and most productive timber resource, as well as the most important water-yielding areas in the central Rocky Mountains. They also provide habitats for a wide variety of wildlife, forage for livestock, and recreational opportunities and scenic beauty. Management must consider all uses if present and future forest resource-related needs of people are to be satisfied without adverse environmental effects. Silvicultural prescriptions must be based, therefore, on stand conditions, silvical characteristics, and resource requirements, tempered by social and economic considerations. Let's look at how various silvicultural systems affect multiple-use values in spruce-fir forests, and how they might be ranked.

THE AUTHOR—Robert R. Alexander is chief silviculturist, Rocky Mountain Forest and Range Experiment Station, maintained at Fort Collins, in cooperation with Colorado State University.

Natural Stand Conditions

In the central Rockies spruce and fir are climax species, but they do not have the age-class structure commonly associated with climax forests. Some stands are clearly single-storied, indicating that spruce-fir can be successfully grown under even-aged management. Others have two or three stories, and multi-storied stands with irregular structure are common. Two or more stand conditions frequently occur on the same tract, and this diversity complicates the choice of silvicultural system needed to meet multiple-use objectives.

Another feature of spruce-fir forests is the imbalance in age-class distribution. Most stands are old-growth sawtimber with few pole or seedling and sapling stands. Composition varies considerably with elevation. At mid-elevations of 10,000 to 11,000 feet, spruce usually forms the overstory, with fir predominant in the understory. At elevations above 11,000 feet, spruce may form nearly pure stands, while below 10,000 feet the proportion of fir increases in the overstory.

Regeneration

Engelmann spruce is the most valuable timber species of the type, and research has been directed toward perpetuating it. Because of high solar radiation at elevations where it grows, spruce does not establish readily in the open. It reproduces best in partial shade,

and many old-growth forests have an understory of advanced reproduction with a fair amount of spruce. If logging damage to established regeneration is controlled, these stands can be managed by removing the overstory. This type of cutting simulates the final harvest of a shelterwood system.

In stands without advanced reproduction at harvest time, spruce regenerates from seed provided that there is a dependable seed supply, that at least 40 percent of the seedbeds are exposed mineral soil, and that environmental conditions are suitable (Roe et al. 1970). Shade is especially important to survival and early growth.

Engelmann spruce seed is light, but less than 10 percent of the seedfall is dispersed beyond 300 feet of the source (Alexander 1969, Ronco and Noble 1971). On shaded mineral soil on north slopes, the maximum clearcut opening likely to restock naturally is 400 to 500 feet in diameter; on south slopes it is only 100 to 200 feet. Moreover, adequate stocking usually requires more than one good seed year. On unprepared and unshaded seedbeds, openings 50 to 100 feet in diameter will restock on north slopes, but will require a number of good seed years. On south slopes under similar conditions, few seedlings survive in openings (Alexander 1974, Roe et al. 1970).

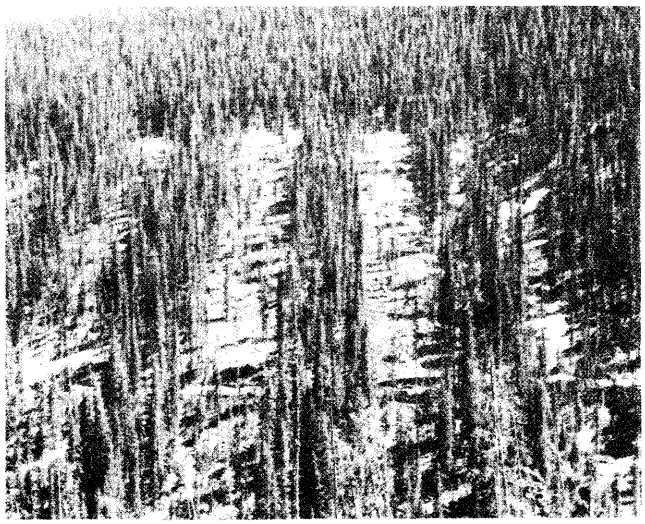
Partial cutting is more likely to result in evenly distributed reproduction than clear cutting, but may favor fir over spruce. While spruce can be artificially regenerated (Ronco 1972), planting has been used primarily to fill gaps where natural regeneration failed.

Silvicultural Systems and Cutting Methods

Descriptions and definitions.—Spruce-fir forests are harvested by clear-cutting, shelterwood, and selection systems, plus their modifications. Because of susceptibility to wind-throw, seed trees are not a suitable way of regenerating old-growth stands.

Clear cutting removes all trees in a single cut either in narrow strips up to 400 feet wide (*fig. 1*), small patches of 3 to 5 acres (*fig. 2*), or blocks of 10 acres and more.

Figure 1. Clear cutting in old-growth spruce-fir on the Fraser Experimental Forest, Colorado. About half of the merchantable volume was removed from strips one chain wide.



Shelterwood can be *standard*, in which all trees are removed in two or three cuts within a 20-year period (*fig. 3*); *modified*, in which about one-third of the basal area is removed in each of three cuts, with the final harvest delayed until reproduction is tall enough to provide a forest aspect; or *simulated*, in which the overstory is removed from a manageable stand of advanced reproduction.

Selection cutting removes selected trees of all size classes over an entire area or in groups of 0.1 to 2 acres (*fig. 4*).

Few spruce-fir forests will be managed solely for their timber resource, but manipulation for aesthetics, recreation, wildlife habitat, and forage and water production also requires removal of trees whether or not the wood has value. The choice of cutting method depends largely on management objectives and on resource, social, and economic values. However, stand conditions, associated vegetation, soil stability, windfall risk, and spruce beetle (*Dendroctonus rufipennis* Kirby) susceptibility also affect the way individual stands can be handled.

Figure 2. Schematic of a patch clear cutting for water production. Openings are about three acres interspersed with uncut areas of equal size.

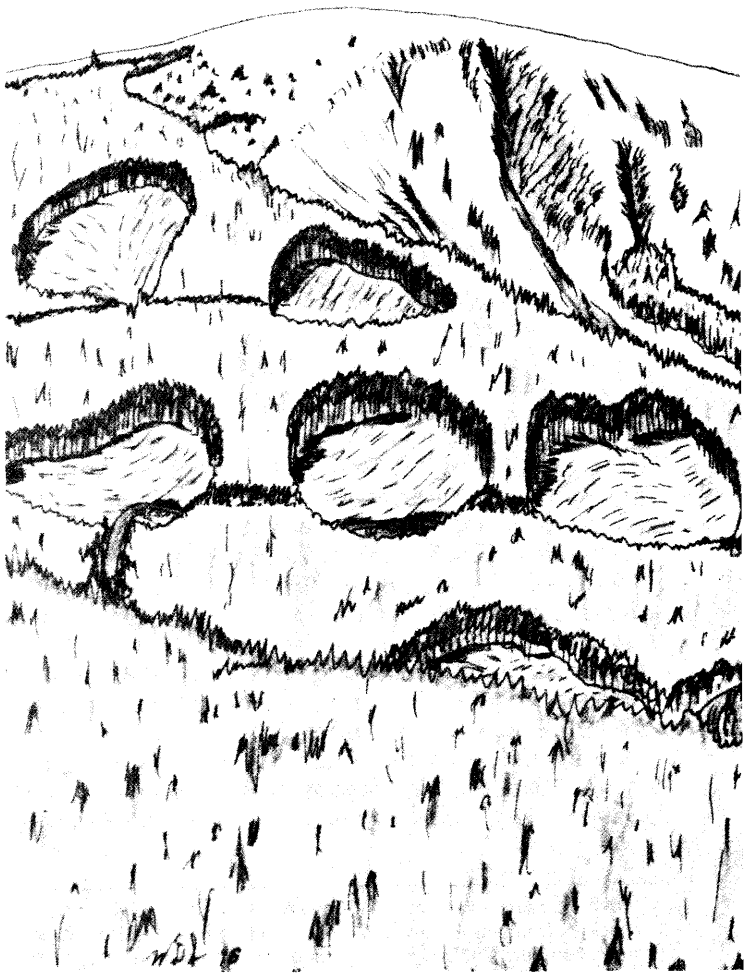


Figure 4. Group selection cutting in old-growth spruce-fir. About half of the merchantable volume was removed from one-third of the area in dispersed openings one chain in diameter.

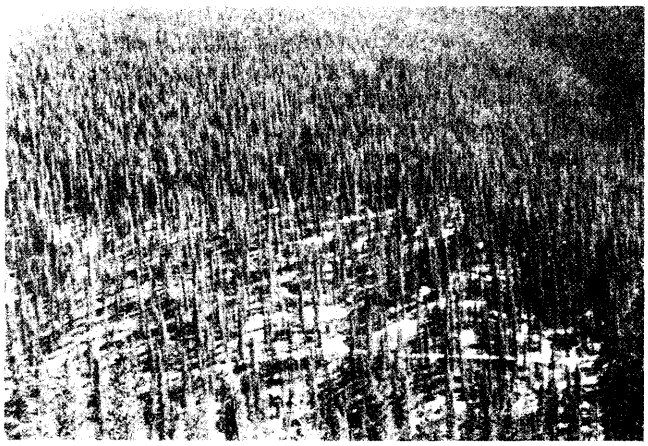


Figure 3. First cut of standard two-cut shelterwood in old-growth spruce-fir on the Fraser Experimental Forest. This cut removed about 60 percent of the merchantable volume, and would have been too heavy for an initial cut in most old-growth stands.

Impact on the Timber Resource

Growth and yield.—Maximum potential annual yield in managed stands of spruce-fir varies from 30 to 120 cubic feet per acre, depending upon site productivity, growing stock level and length of cutting cycle, and rotation (Alexander et al. 1975). Total potential yield can be realized under any even- or uneven-aged system—including clear cutting or group selection when size of opening is near the maximum (2 acres) and there is no time lag in getting natural regeneration. Total yield will be 5 to 10 percent less under a standard or modified three-cut shelterwood than with a two-cut shelterwood. Under a simulated shelterwood, yield increases resulting from reduction in length of rotation are likely to be offset by the higher proportion of fir in the replacement stand. Some reduction in total yield may also occur with individual-tree selection if the proportion of fir is high. With each increase of 10 years in length of cutting cycle (between 10 and 40 years) total yields will increase about 5 percent under clear cutting, standard two-cut shelterwood, and group selection. Length of cutting cycle has less effect under individual tree selection.

Cost of administration.—One of the most important factors affecting the administrative cost of selling timber is the number of entries needed for harvesting. Clear cutting and simulated shelterwood require only one entry. Standard and modified shelterwood require two to three entries, and individual tree and group selection from three to six, depending upon cutting cycles. In managed stands, even-aged systems require a minimum of two additional entries for thinnings, but number of entries under uneven-aged systems would not change.

Costs of sale layout, marking, and sale contract administration are lower for clear cutting, group selection (when near the maximum size), and the final cut of shelterwood systems than for individual tree selection and intermediate cuttings. Costs are reduced because only cutting boundaries are marked, and no time is spent deciding which trees to cut or leave. Sale administration is easier because there are no residual trees to protect and no opportunity to cut unmarked trees.

However, reproduction must be protected at the time of final cut under any shelterwood system, and with group selection when there is a manageable stand of advanced reproduction.

Logging costs.—Harvest usually requires road construction, because large acreages are in unmanaged old-growth stands. Clear cutting is the most economical method in terms of volume removed per unit of road, while individual tree selection is the most expensive. Development of a transportation system to manage spruce-fir forests is a costly front-end investment that will require funding in addition to the value of stumpage at the time of first entry. Once the transportation system has been constructed, road costs should be independent of cutting method.

In addition to producing maximum volume per acre in one operation, clear cutting permits greatest flexibility in selection of logging equipment and minimum concern for protection of residual trees. The first entry of a shelterwood system is intermediate in volume production per acre, requires moderate concern for residual stand, and places some constraints on selection of equipment. The final cut of a shelterwood system has the advantages of clear cutting except for the need to protect the new stand. Individual tree selection requires maximum concern for the residual stand. Group selection requires slightly less if the size of opening is near maximum. Under uneven-aged systems, volumes per entry are intermediate, size-class diversity of products harvested is maximum, and selection of logging equipment is limited.

Impact on Soil and Water Resources

Water yield.—In spruce-fir forests, where 90 to 95 percent of natural streamflow (12 to 15 inches) comes from melting snow, water production is increased by cutting openings in the canopy (*fig. 2*). Size and arrangement of openings are critical. Largest increases in water available for streamflow (2.0+ inches) result when 30 to 40 percent of a drainage is harvested in small clear-cut patches (three to five acres) dispersed over the entire watershed (Leaf 1975, Leaf and Alexander 1975). With this pattern, wind movement across the canopy is changed so that more snow accumulates in the openings than under adjacent stands. Total snowfall in the drainage is not increased by cutting (Hoover and Leaf 1967), but rate of melt in openings is increased, causing the rising limb of the hydrograph to be higher than before timber harvest. Peak flows are somewhat higher, but recession flows are about the same as before harvest. Increase in streamflow is not likely to diminish for at least 30 years, and treatment effect will not disappear until the new stand in the openings is tall enough to change the snow accumulation pattern.

Cutting openings larger than five acres may actually decrease water available for streamflow. Then the wind scours and blows snow into adjacent stands where fall recharge requirements, evaporation of intercepted snow, and evapotranspiration during the growing season are greater.

Group selection cutting can be nearly as favorable for water production as patch clear cutting, but only if openings are near the maximum size of two acres. Increase in water available for streamflow under individual tree selection will be small, for evapotranspiration during the growing season and fall recharge requirements are only slightly less than in uncut stands. Furthermore the snow redistribution effect is lost (Leaf 1975).

Standard and modified shelterwoods result in increases similar to individual tree selection as long as an overstory remains. After final harvest under any shelterwood alternative, water available for streamflow will increase to the level obtained under patch clear cutting, provided that the area cut is similar in size and arrangement to openings recommended for patch clear cutting. The interval of increased water yield will be proportional to time required for the replacement stand to reach sufficient height to modify wind movement across the canopy.

Soil erosion and water quality. — Soil and site conditions are not the same in all spruce-fir forests, but careful location, construction, and maintenance of skid and haul roads should cause no important increase in sedimentation associated with any silvicultural system. For example, on Fool Creek in central Colorado where about 12 miles of main and secondary roads were constructed to remove timber in alternate clearcut strips from about one-third of the drainage, annual sediment yields during road construction and logging were only about 200 pounds per acre (Leaf 1970), and decreased rapidly after logging despite a persistent increase in runoff. Annual sediment yields after logging have averaged about 43 pounds per acre, compared with 11 to 31 pounds from undisturbed watersheds (Leaf 1975).

Nutrient losses and stream temperature changes. — Removal of logs in timber harvest represents a small and temporary net loss of nutrients, since only a minor proportion of the nutrients taken up by a tree is stored in the bole. Clear cutting spruce-fir forests results in a greater immediate loss than individual tree selection, but over a rotation the losses would balance out by more frequent cuts under the selection system. Furthermore, nutrients lost after clear cutting should be replaced in 10 to 20 years through natural cycling as regeneration becomes established.

Comparison of streamflow from logged and unlogged subalpine watersheds in central Colorado provided some indication of effect on chemical water quality. Ten years after clear cutting, cation concentration during a 10-week period was 1.8 ppm greater and cation outflow 5.2 pounds per acre greater on the logged watershed (Stottlemyer and Ralston 1968).

Increases in stream temperature can be avoided, even with clear cutting, by retaining a border of trees along stream channels. Actually, clear cutting to the stream channel and subsequent warming of the water may be advantageous in spruce-fir forests, where streams are frequently small and too cold to support adequate food supplies for fish.

Impact on Wildlife and Range Resources

Game animal habitat.—Spruce-fir forests are summer habitat for mule deer *(Odocoileus hemionus)* and elk *(Cervus canadensis),* and yearlong habitat for blue grouse *(Dendragapus obscurus).* Clear cutting and group selection provide the largest increases in quantity and quality of forage, but game animal use is often limited by the amount of cover available for hiding, resting, and ruminating. Furthermore, forage

availability on summer ranges is not directly related to game animal populations, because carrying capacity of winter ranges limits animal numbers. Mature unlogged spruce-fir stands in Colorado produce enough forage to carry more mule deer than are presently estimated to occupy summer ranges (Regelin et al. 1974).

Dispersed openings 2 to 20 acres in size are used more by deer and elk than smaller or larger openings or uncut timber (Reynolds 1966, Wallmo 1969, Wallmo et al. 1972). Small openings provide little diversity, and overly large openings cause too radical an alteration in habitat, especially if coupled with extensive site preparation and tree planting. As trees grow into seedling and sapling size, forage production in cleared areas diminishes but cover increases. Forage increases again as stands reach sawlog size and cover approaches the maximum for the spruce-fir type.

Shelterwood cutting provides less forage for big game than cutting methods that create openings, and the reduction is in proportion to the density of the overstory and length of time it is retained. On the other hand, shelterwood cutting provides less cover than an uncut forest. Individual tree selection provides forage and cover comparable to uncut forests, thus maintaining one type of habitat at the expense of creating diversity.

Some reduction in the density of old-growth stands is usually necessary to create or maintain drumming grounds for male blue grouse. Shelterwood cutting or group selection that opens up the stand enough to allow regeneration to establish in thickets provides desirable cover. Small, dispersed clearcuts (5 to 10 acres) are also favorable if thickets of new reproduction become established (Martinka 1972).

Nongame animal habitat.—Little information is available on the relationship of cutting methods in spruce-fir forests to specific nongame habitat requirements, but it is possible to estimate probable effects. Clear cutting and group selection that create small, dispersed openings will provide a wide range of habitats attractive to some birds and small mammals by increasing the amount of nontree vegetation—at least initially—and length of edge between dissimilar vegetation types. On Fool Creek, for example, where 40 percent of the timber was cleared in alternate strips one to six chains wide, many species of birds feed in openings and nest in trees along the edge. In contrast, only woodpeckers and sapsuckers have been observed in adjacent uncut stands (Myers and Morris 1975).

Shelterwood cutting provides a variety of habitats attractive to species that forage in stands with widely spaced trees, but not to those that require closed forests or fully open plant communities. Under this system, trees are still available for nesting, denning, and feeding until the final harvest, when consideration should be given to retaining some of the snags and live trees with cavities.

Enthusiasm for habitat diversity should be tempered with caution. Harvest of old-growth timber can be devastating to species that nest or den in snags and in cavities of live trees, feed largely on tree seeds, or require solitary habitats with continuous forest cover. Individual tree selection provides the least horizontal diversity, and favors species attracted to uncut forests or that require vertical diversity. However, snags and live tree cavities can be retained under any silvicultural system.

Livestock grazing.—Much grazing land lies adjacent to or intermingled with spruce-fir forests. Under a mature canopy, forage production is light and generally not readily accessible to livestock. The quantity and quality of forage increases in proportion to the amount of canopy removed. Utilization of available forage is usually greater in large clear cut areas because forage is more accessible to livestock. Forage production in openings decreases rapidly as new trees grow out of the seedling-sapling stage, and it can be maintained only by frequent cuttings.

Impact on Recreation and Aesthetic Resources

Spruce-fir forests provide a variety of recreation opportunities. Users who hike, backpack, ski, tour, or view scenic beauty are generally attracted to forests whose natural appearance is little altered by man's activities (Calvin 1972). In contrast, hunters have best success where man's activities are apparent—timber sales and other areas readily accessible by roads. Fishing is largely done in accessible lakes, reservoirs, and streams. Camping in the conventional sense is at both publicly and privately developed sites served by roads, while a major portion of scenery viewing is by automobile from developed roads. Moreover, most of the winter use of snowmobiles for recreation in spruce-fir forests is on roads. Lastly, some forms of recreation such as downhill skiing and mountain home development require drastic modification of the natural forest landscape.

Clear cutting has the greatest visual impact, and individual tree selection the least. However, variety typical of forests at the highest elevations—whose texture is broken by natural openings—is preferred to the monotony of vast, unbroken forest landscapes at middle and lower elevations (Kaplan 1973).

To enhance amenity values, openings cut for timber and water production and wildlife habitat improvement should be a repetition of natural shapes, visually tied together to create a balanced and unified pattern that will complement the landscape (Barnes 1971). This is especially important for openings in the middleground and background seen from a distance. Modified shelterwood or individual tree selection can be used to retain a landscape in foregrounds.

Individual tree selection, group selection, and modified shelterwood cutting are appropriate in high-use recreation areas, travel influence zones, scenic-view areas, and lands adjacent to ski runs—and also near support facilities and subdivision developments where permanent forest cover is desired. The visual impact of logging can be minimized by cleanup of debris and slash and by careful location of roads.

Conclusions

Figure 5 ranks the effects of different silvicultural systems and their modifications on resource values and timber economics in spruce-fir forests. These relative rankings are based on research and experience, and subject to change as additional information on resource interactions becomes available.

No silvicultural system meets all resource needs, but neither does preservation. Cutting small openings provides maximum yields of timber at minimum costs, promotes the largest increases in water production

without undue reduction in quality, produces diversity in food supply and cover favored by many wildlife species, and is necessary for the development of recreation sites for skiing and home subdivisions. Production and utilization of livestock forage are less than on larger openings, while clear cutting in any form destroys the habitat of wildlife species that dwell in closed forests. Clear cutting can create adverse visual effects if no thought is given to the size and arrangement of the openings, but it can also be used to create landscape variety that will enhance amenity values.

Shelterwood cutting also provides maximum timber yields over the same time interval, but at increased costs; it produces a wide range of wildlife habitats, but with less forage than openings and less cover than uncut forests. Water yields are not increased significantly over natural streamflow until the overstory is completely removed at final harvest. Shelterwood cutting provides a partial retention of the forest landscape, particularly when the overstory is retained for a long period.

Group selection cutting, with the size of opening near the maximum, favors and discriminates against the same resource values as patch or strip clear cutting. It is more expensive and less flexible, however. Individual tree selection cutting can maximize timber production, but it is the most expensive harvest method. Water yields are about the same as in uncut forests. Individual tree selection cutting provides minimum horizontal diversity in wildlife habitat, but favors species attracted to uncut forests. It also provides maximum partial retention of the natural forest landscape. Group selection in very small openings accomplishes about the same things as individual tree selection.

Not all resource needs can be met on a given site, nor is any one cutting method compatible with all uses. Land managers must recognize the potential multiple-use values of each area, determine the primary and secondary uses, and then select the management alternative that will enhance or protect these values. On an individual site it is likely that some uses must be sacrificed or diminished to maintain the quantity and quality of others. ■

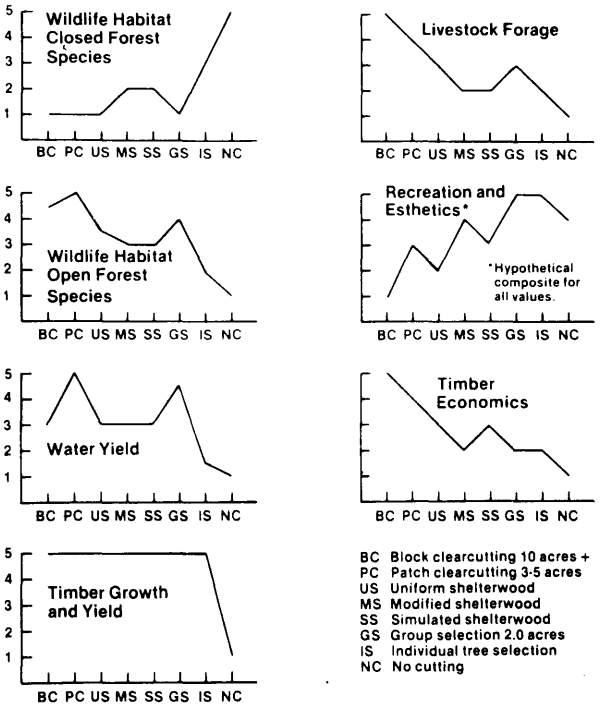


Figure 5. Relative rankings of the effect of silvicultural systems on the resources of spruce-fir forests. Scale: 1 signifies least favorable, 5 is most favorable.

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Section 4(e) of NFMA
The Beneficial or Adverse Effects of Pesticides

I wish to take this opportunity to touch on three items today. (1) The Forest Service program to manage the use of pesticides, (2) an example to illustrate positive efforts to mutually achieve results in pesticide use management, and (3) the National Forest Management Act (NFMA), Section 4(e), a report of pesticides used and the beneficial and adverse effects of these uses.

There is a program to manage the use of pesticides in the Forest Service. FSM 8540 was issued in 1976. It provides policy and direction on the review and approval of pesticide uses, conduct of projects including project planning, project work plans, and project safety plans, training and certification, pesticide selection application and monitoring, safety in pesticide use and a section on reports.

Each Region, Area and Station has a pesticide coordinator. The two Areas and Regions 5 and 6 have full-time pesticide specialists. Regions 1, 2, 3 and 8 have persons with a part-time involvement with pesticide coordination. Region 4 is planning on about a one-half time involvement with pesticide coordination and NA is planning to hire a full-time person to service Region 9. The Washington Office Forest Insect and Disease Management has one full-time person plus a group leader who spends part of his time in pesticide coordination. Two additional staff are being hired in the next several months.

I am the multiregional pesticide specialist. I am responsible to the Deputy Regional Forester for State and Private Forestry in Regions 1-6 and 10. I work on those pesticide problems which are multiregional in nature with emphasis on herbicides and minor and specialty use pesticides.

One of the activities with which I am involved is the "Administrative Study for Herbicide Screening and Weed Control Demonstration in Western Forest Tree Nurseries." This activity may be of interest in discussions of implementing Section 4 of the NFMA. The use of herbicides in western forest tree nurseries is very limited at present. However, by their use a 75 percent reduction in weed control costs which results in a $6 per thousand reduction in seedling cost has been achieved. Herbicides are available and their potential usefulness has been demonstrated. Before they may be used, though, or their use accepted by nurserymen, they must undergo thorough testing at various locations to develop safe and effective treatments and also to achieve registration to make their use legal.

Presented at the National Silviculture Workshop, September 1977, Flagstaff Arizona by Roger E. Sandquist, Multiregional Pesticide Specialist, State and Private Forestry, Intermountain Region.

The Western Nursery Herbicide Study was divided into three general geoclimatic provinces: the "Pacific Coast" consisting of Washington, Oregon, and California including 15 federal, state and private nurseries. The "Rocky Mountain - Great Basin" consisting of Idaho, Montana, Utah, Nevada, New Mexico, and Colorado including 9 federal, state and private nurseries, and the "Great Plains" consisting of North Dakota, South Dakota, Nebraska, Colorado and Oklahoma including 6 federal and state nurseries. Drs. Ron Stewart, Russ Ryker and Larry Abrahamson are the principal investigators for the "Pacific Coast," the "Rocky Mountain - Great Basin" and the "Great Plains" phases respectively.

The National Forest Management Act - A report of pesticides used and the beneficial and adverse effects of these uses. As of this time there has been no procedure developed and implemented to respond to this portion of the Act. Other priorities have prevented action on this matter. What I relate to you today are strictly my thoughts on the subject. I urge you to forward your thoughts on this matter to the Program Chairman of this workshop. If nothing else, perhaps this presentation can act as a catalyst in the development of a method to comply with this portion of the Act.

I mentioned earlier that there is FSM direction on the use of pesticides. FSM 8542.11 requires that a project work plan be prepared and as a minimum include: (1) the treatment objectives, (2) a detailed description of formulation and application specifications, (3) a description of the organization of field crews to be employed, including job descriptions, lines of responsibility, and interagency coordination, and (4) the quantitative and definitive procedures by which treatment effectiveness can be accurately assessed.

Posttreatment evaluations for all projects using pesticides are required in FSM 8544.33. Knowing the treatment objectives and given the procedures to assess treatment effectiveness the posttreatment evaluation can be performed and benefits can be determined. The underlying assumption is that there is reliable information available to state your objectives in terms of benefits expected and that the procedures to measure treatment effectiveness relate to the stated objectives.

In addition to describing benefits, the posttreatment evaluation should also describe, if feasible, (1) methods of improving application techniques and optimizing timing and dosage rates, (2) whether safety precautions were adequate, and (3) what other factors may have contributed to meeting or failing to meet project objectives.

Since all pesticides that are used in project activities are either registered by the U.S. Environmental Protection Agency or are used under an experimental permit issued by EPA, there is no reason to anticipate any significant adverse effects from their use. Because of the presence of sensitive areas or a desire to assess the applications performance in placing the material on target various types of monitoring

may be performed. No further record of unanticapted happenings is made unless an incident occurs. Examples of incidents are injury or death of persons working with pesticides, crashes of spraying aircraft or accidental dumping or spilling of pesticides, or adverse effects to humans, and other non-target plants or animals. Incidents are to be reported by following the procedures in FSM 8546.2.

To summarize at this point I have described several requirements outlined in the Forest Service Manual. Meeting these requirements will give the raw information on a project basis to determine the beneficial and adverse effects of the use of the pesticide in the project. Also, up to this point additional information will not be required from the districts or forests.

The posttreatment evaluation plus the reports of incidents are valuable information as it may be used in planning future work. Also forest or regional staff people will have a firm information base upon which to approve projects.

Now How do we Translate This Information into a Report to Congress?

Since this is a national report the Washington Office must provide the leadership. Each functional staff; Forest Insect and Disease Management, Timber, Range, Wildlife, Recreation, Watersheds or whoever might have objectives which are met by the use of pesticides should provide the basic quantitative and definitive procedures by which effectiveness of a pesticide use is assessed. This is necessary to provide a meaningful report.

As I visualize it, the report to Congress will be a compilation of regional reports. This is to preserve the differences that there may be in regional pesticide use, their benefits and their adverse effect, if any.

The Washington Office would provide the outline which the districts would use in reporting to the Supervisors Office which in turn reports to the Regional Office. This is to provide continuity in reporting.

The Washington Office would also provide the screening mechanism; that is, an example of the type of reporting that will be meaningful to Congress. Example: at the Ranger District level the objective of the project could be release of Douglas-fir. The selection of herbicide would be made based upon the major species to be suppressed; for instance 2,4,5-T to suppress bracken fern. However, the Regional report would group into a broader category. Example: 2,4,5-T to release conifers. The benefits could be stated as releasing conifers from competition from vegetation such as blank, blank, blank, on 5000 acres without significant damage to the plantation species. A reduction of

three years in the rotation of these plantations is projected. Adverse effects observed was some off-site damage on 12 acres. The effects were not connected with the selection of herbicide but with pilot error or equipment malfunction.

Another approach would be to emphasize the target pest or the management objective. An example would be to report: 300,000 acres of Douglas-fir were protected from further defoliation from the Douglas-fir tussock moth by using insecticides such as carbaryl and the Douglas-fir tussock moth nucleopolyhedrosis virus. Stopping the defoliation resulted in an estimated savings of blank million cubic feet of lumber, blank visitor days of recreation, and blank in watershed value. Another example could be: 100,000 acres of Douglas-fir plantations were released from grass and broadleaf competition by using the herbicides 2,4-D and 2,4,5-T. No adverse effects were noted, however, several unsubstantiated claims of damage to garden crops of forest residents were investigated.

I have not studied the legislative history thoroughly, but I suspect that either approach would be acceptable.

Shoot and Tip Moths and other Regeneration Pests - Potential Impacts and Control Alternatives[a/]

Pine Tip Moths

There are at least 24 native North American species of Rhyacionia pine tip moths, and one important species introduced from Europe. These include:

European pine shoot moth, R. buoliana
Nantucket pine tip moth, R. frustrana
Pitch pine tip moth, R. rigidana
Southwestern pine tip moth, R. neomexicana
Western pine tip moth, R. zozana

Life history and habits of pine tip moths are generally similar for all species. Larvae feed in new growth, mining out the tissue and causing varying degrees of damage to the new shoot and bud. Some species have only 1 generation per year; others have several. Adults lay eggs on or near the developing shoots, and the larvae move to the shoots and begin feeding. Pupation takes place in the shoot or in a cocoon attached to the base of the tree, often at the ground line.

Potential impacts from tip moth infestation result from (1) loss of height growth, (2) alteration of tree form, and (3) rarely - tree mortality. The severity of impacts varies with (1) the "aggressiveness" of the insect population - a difficult factor to evaluate, and (2) how fast the infested trees are growing.

[a/] Presented by Robert E. Stevens, Entomologist, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. 27 September 1977.

Evaluating tip moth impact is not easy. Many times damage appears severe intuitively, but vigorous scrutiny has often shown it not to be as devastating as expected. Management objectives are a key element.

Control of pine tip moths is difficult and expensive when extensive areas are involved. The larvae are only briefly vulnerable to application of conventional insecticides, and other contemporary chemical approaches all have drawbacks that more or less severely limit their usefulness. Silvicultural treatments that maximize growth currently provide the only tip moth control practiced on any extensive basis.

Western pine shoot borer

The western pine shoot borer, Eucosma sonomana, another species of olethreutid moth, has attracted considerable attention in the last 5 years, mostly on the West Coast. It also reduces growth in young trees, but unlike its Rhyacionia relatives mines only in the pith, and usually only in the leader, not the laterals. The damage is not as obvious, being manifested in many cases only in reduced terminal growth. Nonetheless, laterals often become dominant, reinfestation occurs over a period of years, and stunted and misshapen trees result. Ponderosa pine is the main host.

The life history of Eucosma has just now been fully worked out, but no control methods have been developed. Because the population density of these insects is low (often only 1 insect/tree) pheromones present a relatively promising potential control technique, and research is underway.

Other regeneration pests

Many other kinds of insects attack young trees, and sometimes cause severe problems. Examples include the pales and pitch-eating weevils in the South, wooly aphids of various kinds, the lodgepole terminal weevil in the West, and a host of others. Most can be controlled, if necessary, by direct or indirect methods. Consultation with forest pest control specialists in every instance will put the manager on the track of the most up-to-date and effective techniques.

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Economic Analysis and Section IV of the National Forest Management Act

Clark Row
Evaluation Methods Research Group
USDA Forest Service
Washington, DC

Abstract--Increased emphasis on economic analysis is one of the major changes called for by the National Forest Management Act of 1976. In Section IV, pertaining especially to timber management, the Forest Service is asked to determine maximum benefits of multiple use, best potential rates of growth, among other criteria. And most importantly, even before we have mastered the procedures for analyzing timber management regimes for timber benefits, we are specifically required to include all resources in the economic analyses.

Viewed from the long-run, the requirements make sense. After all the basic resource we are managing with the public's money is land. And land can and does produce a variety of outputs of value to a wide range of users, whether they pay for them or are free public goods. And Congress does want to know what the public is getting.

What I want to do is discuss some of the problems of expanding economic analyses to cover the new dimensions--as well as improve existing procedures. I will emphasize the areas of costs, values of benefits, and measurement of economic and environmental risk. I will spend little time on the physical tradeoffs, because we have heard several days of facinating presentations on various resource interactions. What is clear from these discussions is that timber resource staffs will increasingly have to coordinate planning, analyses, and execution of projects with their brethren specialists.

The language of National Forest Management Act suggests several rates for economic benefit-costs analyses. Aside from the formal use in selection of projects for budgetary funding, it requires that planning and land use allocation be based on economic analyses. And it requires economic analyses at a variety of different levels. One thing seems obvious--that the Forest Service needs a strategy for economic analyses. Economic analyses at various levels, general or functional emphasis, should each not consider all aspects but information should be passed from one type of analysis to another. There is a good parallel with the general planning process, of which economic analysis should be an integral part.

The parts of benefit-cost project analyses

Lets look at the fundamentals--the phases of a benefit-cost analysis are:

A. Develop a schedule of what is expected to happen, physically (or biologically)

1. Include, if possible, the type and general likelihood of foul ups--regeneration failure, fire, pests, etc.

B. Translate the schedule into values.

1. Costs for treatments, maintenance, supervision and administration.

2. Values for outputs, if they exist or can be approximated.

C. Analyze the schedule--or reduce it to one or several decision criteria--such as a benefit cost ratio, rate-of-return.

D. Write a report that puts the results of analysis into perspective, considering biological, economic and environmental risks.

Lets consider some of the details. First, in developing the schedule of what is expected to happen it is obvious that some of the older methods are increasingly unsatisfactory. Timber yield tables, for example, often don't distinguish planted from natural stands. Genetic improvement, fertilization, precommercial thinnings need to be factored in. Utilization and even the basic units of measure have changed.

Silvicultural options have become so complex that I would recommend gradually phasing out working with simulators rather than with old tables. Many forest types have some simulations for them, and almost all recent research has been towards simulators. The computer program MULTIPLOY has recently been expanded to include some 20 simulators. A major advantage of simulators is that other outputs can be linked to them.

Other outputs I tend to classify into two groups. First is the "shrubbery type"--grass, forbs shurbs, and non-commercial trees. They don't move, generally they grow in a systematic manner. With adequate information they are easy to simulate. But they generally do not have immediate or direct values. They are only productive if they are eaten, seen, or beneficially contribute to ecological stability.

The second output type is "critters"--wildlife, livestock and live recreationists. (Live recreations differ from TV-numbered). Critters move about, and may underutilize, or overutilize the habitat. Because the habitat exists does not mean that it will be used. It often depends on the management and condition of surrounding areas.

The major problem is that associated with wildlife, livestock, or recreationists there is a management regime that must be coordinated with the timber management regime. The interactions of the management regimes may be highly dynamic, with quantities of some outputs dependent on the phase of anothers management cycle. For example wildlife and range outputs may be large only in the regeneration period.

Costs of management

For years the Forest Service has been struggling with the problem of being able to regenerate reliable and reasonably accurate costs. Two new developments promise to improve the situation.

First, there is currently underway plans for testing the new PAMARS accounting system. This will be an accrual system in which costs will be identified by project as actually spent, not as obligated and intended to be spent. It should give feedback to managers on how much individual projects cost, and statistical analysis can be made on the characteristics of projects that cause either high or low unit costs. Being able to match project outputs with project costs will be a major advance. But the system cannot be expected to give miracle results immediately or without conscientious attention to good basic input information.

The second major step is the study of fixed costs or what in the Forest Service is becoming known as stewardship costs. This study will try to develop procedures to estimate what a National Forest's costs would be if no new investments and no commodity outputs were produced. Essentially, it will ask how much it would cost just to keep the National Forest at a minimal level of operation. Such costs should then not be included in the overhead charged to resource projects. This is a major step toward using marginal costs in benefit-cost studies.

Valuing benefits

Analysts have long complained that non-timber values, particularly non-market values, were uncertain and hard to measure. They distinguished this from timber, where current stumpage values are obtainable from sales records. This is going to be particularly important in implementing Section IV of the National Forest Management Act.

Lets look at the problem of estimating future values of outputs. First we must realize that we seek to estimate future unit values of outputs with future qualities and harvested under future utilization rates. Here is where timber with most of its benefits far into the future, is at a disadvantage. We know that timber values have risen faster in the past than general prices, but to what extent this will continue is uncertain. We know that second growth has different quality characteristics than the older growth now being cut in western National Forests, but we cannot be sure the present market price structure will continue. We are also unsure how extensive will be advances in utilization.

However these aspects are pertinent to market values. There are three other types of resources for which there are no firm values. These are:

A. Resources outputs with administratively set prices--such as range use (grazing fees), and recreation at developed sites (with various fees and charges), wildlife (with hunting permits).

B. Resources outputs with no markets but benefits that can be estimated in some sort of utility to users. These include water yields, dispersed recreation including wilderness use.

C. Environmental impacts with indirect impacts on many people but almost completely intangible effects.

There are techniques for obtaining values for these impacts. They include panels that estimate willingness to pay, indirect methods to estimate the expenditures some may make to get access to the resources, and other means.

However, if these are going to be used extensively, there must be systematic programs to gather such values on a local level. Organizations must be created to collect and analyze the information much as the timber appraisal system does, even if on a reduced scale for other resources.

Handling risks and losses

An area that is relatively little explored is the handling of risks and losses. Timber burns, and is attractive to a variety of fungi and insects. Actually timber growing is a very risky business. These risks include not only those of loss of timber and other production, but also of environmental damage.

Oddly enough the National Forest Management Act is not explicit on how extensively these must be considered. But it is clear that objective analysis of resource management must include these.

In this area procedures are badly needed on how to incorporate risks. This is possible for losses, but highly difficult for environmental effects.

Concluding nightmare

The Forest Service is already spending about 30 percent of its funds on planning and various forms of economic and environmental analysis. The National Forest Management Act seems to require much more.

The real challenge is to streamline, standardize, and improve planning and evaluation at the same time. Evaluations should not be special exercises, but should be part of our ongoing programs.

Chief's Study of Reforestation and TSI

By

Jim Sabin and LaMont Engle

1. Chief decided on Study in summer, 1976.
   Approved Study plan in December 1976.

2. Broad objective of Study.
   Prepare a report that summarizes the current state of the reforestation and TSI programs on the National Forests. Report will identify problem areas and recommend an action plan for correcting these problems.

3. Why the need for the Study.

   (a) Increase in these programs.
   FY 1971 - $19.4 million.
   FY 1977 - $63.2 million.

   (b) GAO and/or Office of Audit reports pointed out.

   1. Need to accelerate reforestation and TSI efforts.
   2. Need to prepare better inventory data and prescriptions.
   3. Insure funds are used on a priority basis.

   (c) Since 1973, the Department has asked for an evaluation of reforestation and TSI programs.

   (d) Concern by Congress---especially about backlog---expressed in---

   1. National Forest Reforestation Fund Act of 1972.
   2. National Forest Management Act of 1976.
   3. Annual appropriation hearings.

   (e) Forest Service internal concern.

4. Study team composed of---
   Roy Bond, Team Leader.
   Dave Ketcham---replaced by Phil Archibald.
   Bob Van Aken.
   LaMont Engle.
   Jim Sabin, R-8.

Assisted by many Washington Office Research, S&PF and NFS people, and by many regional people particularly regional silviculturalists in those Regions visited.

5. More detailed objectives.

(a) Summarize and evaluate current national direction.
(b) Summarize Region and National Forest standards for identifying treatment opportunities and quality of work.
(c) Determine reliability of treatment needs statistics.
(d) Evaluate the recordkeeping and reporting systems.
(e) Summarize and evaluate the program planning budget development process.
(f) Summarize and evaluate control systems and the followup action taken.
(g) Evaluate cost effectiveness of these programs.
(h) Determine the degree to which allowable harvest is responsive to intensive management investments.

6. Schedule of Study.

(a) Original.

1. Washington Office phase---12/76 - 3/77.
   Compiling and analysing information from Washington Office and Regions.
2. Regional Study phase---4/77 - 11/77.
   Study of 3 Regions.
3. Draft report phase---12/77 - 2/78.
4. Present report to Chief and Staff---3/78.
5. Implementation of action plan---5/78 (to start).

(b) Progress to date.

1. Washington Office phase completed March on schedule---primarily by Van Aken and Engle.
2. Regional Study phase completed in July 1977.
   Regions 8, 6, and 24 were studied.
   Excellent cooperation by regional, forest, and district people. Research also involved.
3. In process of preparing draft report to be done by November 1.

Lamont will talk about our tentative findings and the schedule from here on out.

When we scheduled this talk, we believed we would have had a firm draft of our report. However, we are not that far along so we cannot give you definite alternatives or recommendations.

The only definite thing I can say is that we will try desparately not to recommend more task forces. Most actions will be within the present organization set-up.

Tentative Study Team Subject Matter for Their Report

A. Definitions. There is a lack of a common understanding of the terms "backlog" and "needs" and now there needs to be an interpretation of "best potential rate of growth."

B. Technical---Environmental---Coordination. There are many technical, environmental, and coordination situations which prevent effective and efficient completion of reforestation and TSI work. This has resulted in increased costs and under-accomplishment.

C. In-place Data. There is a lack of complete in-place data necessary to prescribe reforestation and TSI. There is a wide variation in interpretation of the process of silvicultural examination and prescription.

D. Data Systems. Data systems are not fully providing the support needed for staff and line administration of the programs.

E. Standards. Standards are lacking for determining if an area needs treatment, to set priority among treatments, to define acceptable work in the evaluation process and to clarify communications regarding objectives of management.

F. Cost-effectiveness. Confusion exists as to how C/B and other types of economic analysis should be used in administering the programs.

G. Program Planning. There are weaknesses in our program budgeting system and in our ability to implement the system.

H. Budget Execution. There are weaknesses in the budget execution process.

I. Evaluation. The Service lacks effective quality evaluation of reforestation and TSI work. This has been mentioned several times here.

J. Accountability. There is a lack of accountability for accomplishment.

K. Commitment. There is a lack of demonstrated general line commitment to programs. ---The Ranger said it all yesterday.

L. Personnel. There is a shortage of fully qualified personnel to do the kind of silvicultural job needed for successful resource management.

M. Administration of Program. Implementing Congressional intent.

N. Direction. Made a part of previous issues. ---We found weak direction in some areas---strong in others.

O. Future Plans.

Schedule

November 1	-	Rough Draft
November 14-18	Group 1	R-1, R-2, R-3
November 21	Group 2	R-5, R-6, R-9, R-10
R-8		
	rewrite	
February 1, 1978	-	Report to Chief of Staff
February	-	Prepare Action Plan

Presented by Tom Greathouse

Nursery Needs for Section 4 of NFMA

NFMA

The NFMA requires that all forested lands shall be maintained in appropriate forest cover to secure maximum benefits from Multiple Use-Sustained Yield Management. In Section 4, funds are authorized to secure seed and grow seedlings to restore vegative cover. Section 4 also specifies that funds for reforestation and other treatment shall include moneys for "...improving growing forests...." Section 6 gives authority to "...permit increases in harvest levels based on intensive management practices such as reforestation, thinning, and tree improvement...." Under these guidelines nursery production is expanding. In the near future it is expected that there will be an added function: the production of large quantities of associated shrub and non-commercial tree species to meet wildlife management, recreation, and other demands.

Impact on Nurseries

First, let's look at the impact of recent legislation on production of seedlings to restock commercial forest land.

Congress has authorized funds to reforest the backlog of understocked commercial forest land. The work load is illustrated in this table.

Nursery Production (Thousands)
(For Commercial Forest Species)

Region	Nursery	F.Y. 1976	Estimated 1981-85	Estimated 1986-on
1	Coeur d'Alene	15,600	18,000 G[A]	10,000 G[A]
2	Mt. Sopris	3,450	15,000	7,000
2	Bessey	2,050 B	4,000 B	4,000 B
3	Albuquerque	100 C	35,000	18,000
4	Lucky Peak	7,400	15,000 G	8,000 G
5	Humboldt	7,650	26,000 D	18,000 D
5	Placerville	8,700	15,000	12,000
6	Wind River	30,900	25,000 G	20,000 G
6	Bend	5,000	10,000 G	10,000 G
6	Medford	0	40,000 E	40,000 E
6	Beaver Creek		5,000 C	5,000 C
6	Additional	0	20,000	?
8	Ashe	20,500	20,000	20,000
9	Eveleth	2,600	2,600	2,600
9	Toumey	4,400	4,400	4,400
10	Petersburg	0	1,000 C[F]	1,000 C[F]
		108,350	256,000	180,000

A. 9-10.5 MM for R-6
B. 2.05 MM for St. Nebraska
C. Container stock
D. 6 MM for R-6
E. 6 MM for R-5
F. 0.1 MM for St, Alaska
G. 0.1-1.0 MM from bedhouses

No doubt, some of the figures do not match the latest regional estimates. It would be appreciated if each Region would submit any needed changes either formally or informally, today or later by mail,

Greenhouses, Bedhouses

Part of the impact of RPA and NFMA is reflected in the use of greenhouses or bedhouses to produce about 10% of F.S, seedling needs. Although more expensive, both techniques permit growing plantable seedlings in one versus 2-3 growing seasons. This gives some flexibility in planting areas damaged by fire or other unforeseen problems. Under some conditions the use of containerized seedlings may extend the planting season by a few days. But the main advantage is that vigorous, plantable seedlings can be produced in 3-6 months.

Use of bedhouses to grow vigorous, bare rooted seedlings in 3-6 months may be more desirable in the long run than use of containers. This will avoid deformation of the root system.

Advice on Greenhouses and Bedhouses

If a Region wishes to use either type of artificial environment to control temperature and humidity, they should consult with experienced researchers Jim Jenkinson (Berkeley), Pete Owston (Corvallis), Russ Ryker (Boise) or Dick Tinus (Bottineau, N.D.) and with Regions which have active, successful projects.

It is desirable to use tested techniques and building designs both to save funds and to get better results. Let us not fall into the category of foresters who fail to use 50% of the knowledge already available.

Associated and Non-commercial Species

In 1977, almost 100% of F.S. nursery production is in commercial forest tree species. The NFMA will change this, but without a crystal ball I will not predict how much space and effort will be needed to produce associated and non-commercial tree species which will be needed for wildlife, recreation, watershed, range, or other non-timber uses. This will insure that "...all forested lands...be maintained in appropriate forest cover...."

Some nursery managers have been anticipating this change. Research has been conducted on hard-to-germinate species. Such work is encouraged, but it should be coordinated between Regions to prevent duplication. It should be done in cooperation with research to get maximum benefits.

Seed for Nurseries---Tree Improvement

Section 4 states that funds will be made available for "...improving growing forests...." For new forests, improvement starts with seed which has an inborn potential for growing greater quantities of better quality material.

Fortunately, the simplest form of tree improvement can be practiced by every ranger. First, it involves collecting a 5-10 year supply of seed from trees in each zone or habitat type which have demonstrated average or better response to their environment. Then, after the nursery has converted the seed into seedlings which meet the ranger's

standards, the seedlings must be planted in the same environment in which the parent trees grew. One exception to this would be if long-term trials have proved that seed from a different zone or habitat will respond better than local seed.

Although use of local seed from selected trees does not guarantee a large increase in yield, it insures that yields in the next rotation will be at least equal to the previous harvests. The alternative, using untested seed from a different environment, will almost certainly result in reductions in yield.

A second exception could be due to an important change in the environment. A south slope might have been changed sufficiently by logging and slash disposal so that a nurse crop of some sort, or artificial shade for each seedling, is necessary to establish the harvested species.

Nursery Practices

Nursery expansion in the West is providing better handling and storage facilities. Efficiency should increase sharply.

Weed control techniques are also being improved.

Region 6 has recently adopted a nursery stock catalog which assists the ranger in specifying the height, stem diameter, and type of root system which he thinks best for each. While not a panacea,

this is another step in improving communications between field and nursery. It should increase plantation success.

Each nursery manager should ask himself if he is using all the knowledge available. If so, and he still needs help, he should seek help from Research personnel. If not, he will leave monuments to his ignorance and to his lack of professional integrity. The monuments will be in such forms as unproductive land and degraded watersheds.

Support

Within the past few years Congress, the forest industry, the home building industry, and others have begun supporting reforestation efforts. They realize that this starts with seed of better genetic potential, proceeds through efficient nurseries and terminates when trees are established. With such support, there is a demand for better performance.

It is no longer enough to say we planted so many acres. "Acres Established" is now the key.

GPO 923-748