TIMBER MANAGEMENT PLAN CONFERENCE

HOT SPRINGS, ARKANSAS

MARCH 28 - APRIL 8, 1949

# U. S. DEPARTMENT OF AGRICULTURE

## FOREST SERVICE

U. S. GOVERNMENT PRINTING OFFICE 100117

4018

MANAGEMENT PLAN CONFERENCE
HOT SPRINGS, ARKANSAS
MARCH 28 - APRIL 8, 1949

TABLE OF CONTENTS

23402

4018

| No. | Item | Author |
|---|---|---|
| 18A | Methods Now Used in Calculating Growth, Mortality and Yield, R-8 | A. J. Streinz, R-8 |
| 19 | Methods of Management and Methods of Regulation of Cut - Western Working Circles | A. A. Hasel, R-5 |
| 19A | Management of Lodgepole Pine | B. Lexen, R.M. |
| 19B | Methods of Management and Methods of Regulation of Cut in the National Forests of the North Pacific Region | P. A. Briegleb, P.N.W. |
| 20 | Methods of Management and Methods of Regulation of Cut, R-8 | A. J. Streinz, R-8 |
| 20A | Management of Second Growth Shortleaf - Loblolly-Pine-Hardwood Stands | R. R. Reynolds, S.S. |
| 20B | Methods of Management and Methods of Regulation of Cut, Eastern Working Circles, R-7 | D. W. Tabbutt, R-7 |
| 20C | A Method of Regulating Cut in Individual Stands | P. J. Zehngraff, L.S. |
| 21 | Policies and Legal Limitations Affecting National Forest Timber Management Activities | I. J. Mason, W.O. |
| 22 | Management Plans for Cooperative and Federal Sustained Yield Units | L. S. Gross, W.O. |
| 23 | Form and Preparation of Timber Management Plans | C. O. Lindh, R-3<br>D. W. Tabbutt, R-7 |
| 23A | Timber Management Plan Outline, R-8 | A. J. Streinz, R-8 |
| 24 | Control Records, Harvesting Plans, Timber Management Plan Revisions | P. A. Grossenbach, R-4<br>A. A. Hasel, R-5<br>A. W. Sump, R-9 |
| 25 | The Value and Use of Timber Management Plans as a Public Relation Tool | D. N. Matthews, R-1<br>P. A. Grossenbach, R-4 |
| 26 | How to Train Management Planners | W. T. Murphy, W.O. |
| 28 | Criticism of "Timber Management Plans on the National Forests" | W. H. Lund, R-6<br>P. H. Bryan, R-8<br>C. O. Lind, R-3 |

3351

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Address Reply to
CHIEF, FOREST SERVICE
and refer to

WASHINGTON 25, D. C.

S
SUPERVISION
Meetings
(Management Plan Conference)

January 12, 1949

Regional Foresters, Director, Tropical
Region, and Directors, Experiment Stations

Dear Sir:

Reference is made to Mr. Granger's circular letter of November 1, 1948 and subsequent correspondence.

We have delayed issuing the program for the management plan conference because it took some time to develop the program and to make sure that we selected a period during which hotel accommodations could be obtained at Hot Springs. The dates have been set -- March 28 through April 8.

Region 10 and the Rocky Mountain Station have advised that it will be impracticable to send representatives to the Conference. Because of the desirability of limiting total attendance only a few Research men were invited, largely on the basis of Regional recommendations. This letter is going to all Regions and Stations. If any additional Station has a man whom they would like to send to the Conference and who could contribute to it, we will be glad to give consideration to such a recommendation.

The general procedure for the Conference is stated in the enclosed program. It is hoped that everyone will follow this procedure. Each designated topic leader should write the listed contributors shortly after receiving the program so that there will be ample time to develop all papers. As indicated, material from contributors may be incorporated in the paper presented by the topic leader or may be presented individually, the decision in each case depending upon the wishes of those involved for the particular topic.

Hot Springs is served by the Missouri Pacific and Rock Island Railroads, as well as the Chicago and Southern Airline. Some of those attending no doubt will have to change at Little Rock, Arkansas, from which point there is frequent bus service, as well as train and airline connections to Hot Springs. Everyone should plan on arriving at Hot Springs Sunday March 27 so that the Conference can get under way promptly Monday morning. It is anticipated that the entire two weeks will be needed to cover the subjects which should be discussed. The program has been arranged in what appears to be a logical order, but it is flexible and it may be desirable to make some changes during the Conference.

(Over)

2-Regional Foresters, Director, Tropical Region, and Directors, Experiment Stations--1/11/49

Each man who will attend should arrange for his own hotel reservations by writing Forest Supervisor M. C. Howard, Federal Building, Hot Springs National Park, Arkansas. It appears likely that we will be quartered in two nearby hotels. It is understood that the usual accommodation will be single rooms with connecting baths. Region 8 has advised that hotel rates should be about the usual commercial scale during this period. It is important that Supervisor Howard be notified promptly so that firm reservations may be made well in advance of the Conference.

The Supervisor will furnish Mr. Reynolds a list of those for whom reservations have been made at Hot Springs, so that Reynolds can make the reservations at Crossett for Sunday and Monday nights, April 3 and 4.

It is anticipated that the final Conference session will last all day Friday April 8, and probably most of us will find it best to plan on leaving Hot Springs the following day.

The one day field trip on the Ouachita and the day and a half at Crossett may be rainy and muddy. It would be well to bring suitable clothing.

It is hoped that some of the men attending the Conference will take advantage of their presence in the South to spend a day or two after the Conference seeing some intensively managed working circles in Region 8. The coastal plain southern pine forests in Mississippi and Texas should prove to be particularly worth while. Region 8 would appreciate hearing from those who wish to take this sort of a trip.

If anyone whose name appears on the program finds it impossible to attend the Conference, he should prepare or participate in the preparation of papers for which he is assigned as topic leader or contributor. Any leader who cannot attend should send the required number of papers for distribution at the Conference to Supervisor Howard and the necessary number of copies to this office.

It is hoped that all those who attend the conference will be prepared to join in the discussion of each topic. The material furnished with the program is intended to serve as a guide but not an all inclusive outline for the various topics. Each leader should feel free to develop his subject as he thinks it should be handled, but should consider the points mentioned in the supplemental material.

If there are any suggestions for additional material or procedure in handling the Conference, please let us have them promptly.

Very truly yours,

IRA J. MASON, Chief
Division of Timber Management

BY [signature]

Enclosure

# MANAGEMENT PLAN CONFERENCE
# HOT SPRINGS NATIONAL PARK, ARKANSAS
# MARCH 28 TO APRIL 8, 1949

## Personnel Participating

**Washington Office**

I. J. Mason
H. E. Ochsner
L. S. Gross
L. I. Barrett
W. T. Murphy
J. T. Osborne

| Region | | Station | |
|---|---|---|---|
| 1 | D. N. Matthews | | |
| 2 | T. Krueger | L. S. | P. J. Zehngraff |
| 3 | C. O. Lindh | | |
| 4 | P. A. Grossenbach | N. E. | M. Westveld |
| 5 | A. A. Hasel, B. O. Hughes | | |
| 6 | D. J. Kirkpatrick | P. N. W. | P. A. Briegleb |
| " | W. H. Lund | | |
| 7 | D. W. Tabbutt | Southern | P. R. Wheeler |
| 8 | P. H. Bryan, A. J. Streinz | " | R. R. Reynolds |
| 9 | A. W. Sump | S. W. | G. S. Meagher |
| " | H. C. Cook | C. S. | R. D. Lane |
| TR | W. H. Cole | | |

Conference Secretary E. M. Howell

## Procedure

1. All papers will be mimeographed. Each author should bring 25 or more copies to the Conference, for distribution to those attending. The Conference Secretary will be responsible for distribution of each paper in advance of presentation. In addition, 30 copies of each paper should be sent to the Division of Timber Management in Washington. Complete sets of papers, committee reports, etc. will be assembled after the Conference and one set furnished each Region and Station.

2. Each topic presented will be open for full discussion. In most cases, one or two men are assigned to aid the topic leader (who is listed first) in the presentation. The objective is get before the Conference the problems, plans and ideas of the various regions. In each case of multiple assignment the leader is responsible for contacting the others, ordinarily by mail, for their views. These may be incorporated in the written paper prepared by the leader, or may be written separately and presented by the author.

   Regional or Station representatives not listed for any topic who desire to present information or ideas thereon (in addition to the verbal discussion) may forward their material to the topic leader

(over)

for incorporation in his paper. This may be particularly desirable in topics 11, 12 and 18. This procedure is not intended in any way to inhibit discussion of the topics as presented.

3. The Chairman of each session will be responsible for encouraging and directing full discussion of each subject after it is presented.

4. The Conference Secretary will arrange for advance distribution of papers, take notes on discussions, record points in controversy and conclusions reached, and be responsible for clerical help for typing committee reports or other services.

5. Working committees will be appointed as need arises. They will be charged with analyzing papers and discussion pertaining to assigned subject, and will report back to the Conference.

MONDAY MARCH 28

Chairman - Bryan

Program

| | |
|---|---|
| Announcements | Howard |
| 1. Purpose of Conference | Mason |
| 2. The Timber Management Plan Situation | Gross |
| 3. Timber Management Plan Needs and Programs | A Statement by the Representatives of Each Region |
| Management Policy | Hughes |

TUESDAY MARCH 29

Chairman - Lund

| | |
|---|---|
| 4. The Working Circle - Concept, Boundaries, Subdivisions. | Lindh<br>Kirkpatrick<br>Sump |
| 5. Objectives of Management; Coordination with Other Uses | Krueger<br>Matthews<br>Reynolds |
| 6. Basic Data Needed for Timber Management Plans | Tabbutt<br>Matthews<br>Meagher |
| 7. Stop-gap Timber Management Plans | Kirkpatrick<br>Streinz |
| 8. Transportation Planning for Timber Management Plans | Matthews<br>Lindh<br>Cook |

(over)

## WEDNESDAY MARCH 30

Chairman - Meagher

| | | |
|---|---|---|
| 9. | Applying Silviculture to Management Planning | Barrett |
| 10. | Intensifying Management | Ochsner |
| 11. | Use of Aerial Photographs in Management Planning | Sump<br>Krueger<br>Kirkpatrick |
| 12. | Inventories for Timber Management Plans | Streinz<br>Grossenbach<br>Hasel |
| 13. | Development of Timber Management - Ouachita N. F. | Bryan |

## THURSDAY MARCH 31

Field Trip - Ouachita National Forest

Group will be split into two parties. Each party will be conducted by Ouachita personnel over one or more working circles to observe and discuss management practices and the results thereof.

## FRIDAY APRIL 1

Chairman - Lindh

| | | |
|---|---|---|
| 14. | Appraisal of Ouachita Field Trip | Lund |
| 15. | The Use of Yield Tables in Predictions of Growth, Mortality and Yield | Briegleb |
| 16. | Prediction of Growth, Mortality and Yield by Stand Projection Methods | Wheeler |
| 17. | Continuous Inventory as a Basis for Determining Growth, Mortality, and Yield | Osborne |
| 18. | Methods Now used in Calculating Growth, Mortality, and Yield | Kirkpatrick<br>Streinz<br>Cook |

SUNDAY APRIL 3

Travel to Crossett, Arkansas, Transportation by R-8.

MONDAY APRIL 4

Field Trip - Crossett Experimental Forest

Sample Plots and Demonstration Areas. Intensive Management in Shortleaf-Loblolly Hardwood Type — Reynolds

Evening Session at Crosset.

(Chairman - Ochsner)

Round Table Discussion of Application of Principles of Intensive Management to National Forests

TUESDAY APRIL 5

Morning - Opportunity to see sawmills, sulfate pulpmill, hardwood distillation plant, wood preservation plant, or logging by Crossett Lumber Company.

Afternoon - Return to Hot Springs

WEDNESDAY APRIL 6

Chairman - Sump

19. Methods of Management and Methods of Regulation of Cut, Western Working Circles — Hasel, Krueger, Briegleb

20. Methods of Management and Methods of Regulation of Cut, Eastern Working Circles — Streinz, Tabbutt, Zehngraff

21. Policies and Legal Limitations Affecting National Forest Timber Management Activities — Mason

22. Management Plans for Cooperative and Federal Sustained Yield Units — Gross



(over)

THURSDAY APRIL 7

Chairman - Kirkpatrick

23. Form and Preparation of Timber Management Plans — Lindh, Tabbutt

24. Control Records, Harvesting Plans, Timber Management Plan Revisions — Grossenbach, Hasel, Sump

25. The Value and Use of Timber Management Plans as a Public Relations Tool — Matthews, Grossenbach

26. How to Train Management Planners — Murphy

FRIDAY APRIL 8

Chairman - Mason

27. Reports of Committees Appointed During Conference

28. Criticism of "Timber Management Plans on the National Forests — Lund, Bryan, Lindh

Adjournment

# Notes on Topics

## Topic 3 - Timber Management Plan Needs and Programs

Assignment - The representative from each Region.

The mimeographed statement may be short, and largely statistical. Tabular data should include: Working circles by name and forest, acreage commercial forest land, timber volume, allowable annual cut, acres planned to cut over annually, date of approved plan (if any).

A summary of the regional situation, including: Number of working circles (and acreage) covered by satisfactory plans, needing new plans or revisions.

Estimated costs of preparing plans; time schedule for bringing plans up-to-date; maintenance schedule.

Each presentation should be aided by the use of maps, charts, photos, etc.

The purpose is to paint the picture of the current management plan situation and the needed program in each region, so that all attending the Conference will have a clear conception of the whole situation.

## Topic 4 - The Working Circle - Concept, Boundaries, Subdivisions

Assignment - Lindh (Kirkpatrick, Sump)

What is a working circle? Review of textbooks, SAF Terminology. Propose a definition for adoption by Forest Service. Why are working circles needed? Why not write management plans for entire Forests, groups of Forests, or whole Regions?

Discuss working circle boundaries, and reasons for selecting them. Need for careful analysis so as to select permanent boundaries.

Community aspects. Need for planned community support. Confusing present cross hauls may be clarified in the future if logical working circle boundaries are selected now.

Administrative correlation. Should working circle and ranger district boundaries coincide?

Private or other public lands, intermingled or adjacent. Problems created.

Division of working circle - Consult textbooks and SAF terminology. Should FS standardize?

What standards are needed?



(over)

Topic 5 - Objectives of Management; Coordination with Other Uses

Assignment: Krueger (Matthews, Reynolds)

There may be several classes of objectives, such as economic, silvicultural and administrative.

Should there be a high degree of standardization, or should the local situation govern?

Will objectives vary with site quality, with accessibility, with present and prospective markets?

Should NF management be directed toward maximum volume or highest value production? Should any working circle be devoted entirely to production of small size material (pulpwood, ties, mine timbers, fuel wood) to support local economy?

Discuss priority of uses, such as watershed, recreation, wildlife, grazing, compared with timber production. How far can we go in multiple use on any area, considering timber production, water yields, esthetics, forage production, etc?

Coordination with research - experimental forests, natural areas.

Exclusion of timber operations versus modification of cutting practices in interests of recreation (roadside strips, camp grounds, scenic areas). Can wildlife management practices be harmonized with effective silviculture?

What guide lines or standards are needed?

Topic 6 - Basic Data Needed for Timber Management Plans

Assignment: Tabbutt (Matthews, Meagher)

This subject is of great importance. It has large ecnomic significance. The job of writing and maintaining management plans is big and costly.

Discuss needed data and required accuracy:

Timber - volume, age classes, species, etc.
Land - acreage, site quality, etc.
Topography - as it affects logging, watershed values.
Economics - dependent communities, value of products, markets, etc.
Research results - silvics and silviculture
Protection needs

## Topic 7 - Stop-gap Timber Management Plans

Assignment: Kirkpatrick (Streinz)

Primarily a description of methods and results in R-6. Why and how the job was done. Who did it. How satisfactory. R-8 may have something to contribute.

## Topic 8 - Transportation Planning for Timber Management Plan

Assignment: Matthews (Lindh, Cook)

The importance of planning, developing and maintaining an adequate transportation system for the working circle.

Classes of roads. Standards of construction. Methods of location. Responsibilities for planning, location, construction, supervision, maintenance, "putting to bed".

This is of importance not only in undeveloped working circles, but also where growing stock is being built up. The brand of silviculture which can be practiced is tied closely to the location and character of the transportation system.

Cook should contribute a discussion of the plan evolved by Ranger Nixon, Nicolet N. F.

## Topic 9 - Applying Silviculture to Management Planning

Assignment - Barrett

Importance of determining silvicultural systems before preparing management plans. Effect of silvicultural decisions upon techniques of management plan preparation. Correlation of silviculture and and management in planning.

## Topic 10 - Intensifying Management Practices

Assignment: Ochsner

Distinction between wild and managed forests. Developing desired growing stock. Methods of management related to silvicultural practices and to silvical requirements. Need for, and advantage of, improved markets. Shaping the growing forest -- cleaning, thinning, pruning, sanitation cuts, reproduction cuts, harvest cuts. Treatment applied to individual stands. Importance of timing.

Some steps can be taken in working circles managed extensively.

Measures must be practicable. Cost must be weighed against values.



(over)

Topic 11 - Use of Aerial Photographs in Management Planning

Assignment: Sump (Krueger, Kirkpatrick)

Type of photography. Scale. Ground controls. Type mapping on photos. Area determinations. Volume determinations. Planimetric maps, type maps, topographic maps. Use of photos in field in application of the plan. Costs.

Recommended guides or standards.

Topic 12 - Inventories for Management Plans

Assignment: Streinz (Grossenbach, Hasel)

Purpose and needs of inventories. Consider both working circles with excess growing stock and with deficient growing stock. Ways of fitting the sample to relative values involved. How define relative accuracy required? Consider types, sites, age classes and condition classes.

Data needed on acreage, volume, accessibility, methods of gathering, compiling and using data. Costs. Short cuts and dollar savers.

Topic 13 - Development of Timber Management, Ouachita N. F.

Assignment: Bryan

Brief history of Forest. Creation from Public Domain. Administration by R-3. Purchase history. Early cutting and fire situation. First sales, Trace development of working circles, philosophy of management, methods of cutting. Discuss history of management plans. Development and changes in industry. Present condition of growing stock, site, fire situation, yields, markets. Future possibilities. Lay the background for next day's field trip. Discuss change from volume control to area control; reasons for the change and advantages of it. How does timber management contribute to community stability?

Topic 14 - Appraisal of Ouachita Field Trip

Assignment: Lund

Point up desirable and undesirable features of national forest management as seen on the Ouachita. What practices can be adopted or adapted to western working circles?

Note: - Opportunity also will be had for expression of ideas by others.

Topic 15 - The Use of Yield Tables in Predicting Growth, Mortality and Yield

Assignment: Briegleb

Advantages and disadvantages of the yield table approach to regulation. What field data and office computations are needed? Is it a satisfactory method for virgin stands on western working circles? For second growth? Review the yield tables available for use. How satisfactory are they? Limitations and methods of application of this system. Should entire reliance be based on volume control? Should yield tables be relied upon for the future, should they be checked, revised if need be, or should we plan on some other approach for regulation of cut on National Forest working circles?

Examples of use of this approach.

Topic 16 - Prediction of Growth, Mortality and Yield by Stand Projection Methods

Assignment: Wheeler

What is the stand projection method? Application in even-aged and uneven-aged management. What field data and office computations are involved? Is it necessary to gather and compile voluminous data for each working circle of 50,000 to 100,000 acres or can samples from several similar working circles be combined? Limitations and advantages of this method, for organizing a working circle, for continued use. Examples of use.

Topic 17 - Continuous Inventory as a Basis for Determining Growth, Mortality and Yield

Assignment:

What is continuous inventory? Is it a substitute for other methods, or an aid in application thereof? Discuss the mechanics of application to national forest working circles, west and east. Is this a tool of intensive management or does it apply also to working circles on which only crude silviculture is possible?

Topic 18 - Methods Now Used in Calculating Growth, Mortality and Yield

Assignment: Kirkpatrick (Streinz, Cook)

Methods in use in the different Regions. Checks as to adequacy and accuracy. How accurate is it necessary to predict -- with volume regulation, with area regulation? Cost elements. Is greater coordination or standardization needed between Regions?



(over)

Topic 19 - Methods of Management and Methods of Regulation of Cut - Western Working Circles

Assignment: Hasel (Krueger, Briegleb)

Discuss present practices, recommend future action.

Even-aged versus uneven-aged management: Influence of type, silvical characteristics, topography, markets, other uses (recreation, wildlife) on method of mangement. If even-aged management is prescribed, is it desirable or necessary to restrict size and location of clear-cut areas? Perhaps a third method of management should be recognized - "Even-aged by small groups". Discuss rotations and cutting cycles in relation to even-aged and uneven-aged management. What is basis for selecting rotation? Cutting cycle?

May two or more methods of management be prescribed for different parts of one working circle?

Regulation of cut by volume, by area, by volume and area, all should be discussed. Formulas and other methods in use should be analyzed and discussed. Should species, stands or products be unregulated? How achieve reduction of excess growing stock? Increase of deficient growing stock?

Topic 20 - Methods of Management and Methods of Regulation of Cut, Eastern Working Circles

Assignment: Streinz (Tabbutt, Zehngraff)

Discuss similarly to Topic 19.

Topic 21 - Policies and Legal Limitations Affecting National Forest Timber Management Activities

Assignment: Mason

Review of the authorizations for and limitations on the production and use of national forest timber. There is some confusion as to procedures and "stoppers" which are authorized, required, or permitted by the several laws and regulations of the Secretary of Agriculture.

Forest Service policies are based upon the foundation of laws and regulations. There must be uniformity of procedure under these policies. Specific actions in one Region may have repercussions elsewhere.

Questions of measures which may be taken to support communities, enhance watershed values, insure better utilization of national forest timber will be discussed.

Topic 22 - Management Plans for Cooperative and Federal Sustained Yield Units

Assignment: Gross

Care is needed in preparing plans for sustained yield units established under the Act of March 29, 1944. In Federal Units there is the obligation to develop and use national forest timber resources to the greatest practicable intensity, as support for the dependent community.

The same philosophy applies to Cooperative Units, with the added responsibility of directing the management of privately owned lands.

Discuss the form and substance of these plans.

Topic 23 - Form and Preparation of Timber Management Plans

Assignment - Lindh (Tabbutt)

Minimum requirements are stated in Manual. Hundreds of plans must be written or revised in next five years. This is a continuing job in each Region. Standardization and streamlining are needed. But how much? A Service-wide standard outline? Regional outlines?

Management plan terminology should be discussed. Review SAF definitions. Recommend standard terms and definitions.

Some procedures need study. How get flexibility into plans without sacrifice of needed control? How express cutting budget tied to the ground with enough allowance for fluctuating cuts to make it practicable, and still meet objectives for community support and for desired silviculture?

Management plan conference preliminary to plan preparation - to fix objectives and effect proper coordination.

Who should write the plan? Review and coordination procedure in Supervisor's and Regional Office. Discuss approval of each plan by Chief.

Cost of Plan preparation.

Topic 24 - Control Records, Harvesting Plans, Timber Management Plan Revisions

Assignment: Grossenbach (Hasel, Sump)

This subject should be treated as an analysis of present methods and recommendation for future action. Simplicity in control records is paramount. What about uniformity? Varying methods of management may require different types of control records. The greatest past failure is in maintaining any sort of record of accomplishment.

The harvesting (or cutting) plan translates the allowable annual cut and cutting budget into a short term (3 to 5 years) action program. Does it replace the cutting budget?

Current accumulation of revision data is piously required in many management plans. How much is done? What is needed to keep plans alive and to maintain them as working tools?

Discuss costs.

Topic 25 - The Value and Use of Timber Management Plans as a Public Relations Tool

Assignment: Matthews (Grossenbach)

Some management plans have been mimeographed and distributed to residents of the working circle. Has this proved to be desirable? Other plans have been furnished Forest Schools, etc. Discuss the arguments for and against such procedures. Consider costs and values. Recommend policy and procedure.

Topic 26 - How to Train Management Planners

Assignment: Murphy

Each Region has a big job of management plan preparation and revision. Discuss techniques which can be used to advantage in training personnel (Rangers, Staffmen, Supervisors) to do the job economically and with proper emphasis on technical soundness, combined with brevity and clarity.

Topic 28 - Criticism of "Timber Management Plans on the National Forests"

Assignment - Lund (Bryan, Lindh)

Mimeographed review edition furnished Regions November 18.

This should be a critical review which will form the basis for revision and correction preliminary to issuance in final form.

3806

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Hot Springs, Ark

S
SUPERVISION
Meetings
(Management Plan Conference)

March 28, 1949

# COMMITTEE ASSIGNMENTS
for the
# MANAGEMENT PLAN CONFERENCE

1. Policy Committee

Chairman - Lund
Members - Bryan, Lindh, Hughes
Assignment - All matters pertaining to policy which come before the Conference. Specific consideration should be given to matters pertaining to topics 4, 5, 7, 21, 25, and 26. Recommendations are desired regarding policy which should be adopted for guiding the job of writing and maintaining management plans for all national forest working circles, including how the job should be financed.

2. Silviculture Committee

Chairman - Matthews
Members - Tabbutt, Cole, Zehngraff, Westveld
Assignment - All silvicultural questions which come before the Conference. Specific consideration should be given to discussions of topics 9 and 10, and the silvicultural aspects of 19 and 20.

3. Inventories, Growth and Yield Committee

Chairman - Hasel
Members - Sump, Wheeler
Assignment - Comparison and correlation of the methods used in inventories for management planning, and in calculating growth and yield. Particular attention should be given to discussions under topics 11, 12, 15, 16, 17, 18. Are minimum standards needed? Should there be Service-wide correlation? Are Forest Survey methods satisfactory for national forest use?

4. Regulation of Cut, Cutting Budget, Cutting Plans Committee

Chairman - Streinz
Members - Krueger, Briegleb, Lane
Assignment - All questions relating to the importance, form, use and standardization of methods of regulating the cut, cutting budgets and cutting or harvesting plans. Specific consideration

(Over)

should be given to topics 19 and 20 as to regulation, and 24.

5. Management Plans Committee

Chairman - Kirkpatrick
Members - Cook, Grossenbach, Meagher
Assignment - All matters relating to the preparation and form of management plans. Should plans be formalized, should a standard outline be followed? Recommendations should be made on how and by whom plans should be prepared, reviewed, approved. Special attention to topics 6, 8, 22, 23, 24.

S
SUPERVISION
Meetings
(Management Plan Conference)

May 11, 1949

COMMITTEE REPORTS

The reports of the five committees were discussed during the last day of the Conference, April 8, 1949. Each report was accepted by the Conference, with a few modifications. The reports, as modified, are shown below, with comments of a Washington Office committee. This committee consisted of Mason, Buell, Osborne and Gross.

The committee reports and comments form a valuable part of the record of the 1949 Management Plan Conference. They are guide lines which supplement general policies and practices in the management planning field. They are not issued as formal instructions.

REPORT OF POLICY COMMITTEE, No. 1

1. It is recommended the Division of Timber Management in the Chief's office provide leadership to the Regions in the inventory-sampling field. This should include aerial photos and their interpretation, continuous inventories, timber surveys, survey and measurement sampling and permanent or continuing record keeping. Work in this field should be coordinated with that being done by the Forest Survey organization and arrangements made wherever possible to utilize their experience and personnel for training purposes.

2. It is recommended the Chief authorize Regional Foresters to give final approval to all management plans with the understanding that plans involving cooperative or Federal sustained yield units or Regulation S-3 be submitted to the Chief for approval. Also, if considered essential by the Chief, plans can occasionally be submitted for review on a sampling basis.

3. On the assumption that National Forest lands will be continuously managed for sustained yield production and that management will generally provide for raising quality trees of various commodity sizes, and funds or efforts available should be directed toward more intensive application of silviculture in especially selected areas for production of particularly high quality products, rather than setting aside or designating certain areas for raising specialty products or specified types of trees to be "stockpiled" and only cut during a national emergency.

4. It is recommended National Forest working circles be generally managed with the objective of growing trees suitable for quality products with most of the material for pulp plant use to come from small stem improvement cuttings. In recommending this objective, it is recognized there may be parts of some working circles or even a few working circles that may best be managed for volume production only, because of species or other justified limiting factors.

5. To get on top of the timber management planning job, the committee recommends the Chief establish a definite program for management plan preparation. A schedule somewhat as follows might be established:

1. Each Region by 1951, through conferences or other means, decide on working circle boundaries where this has not been done.

2. Each Region, for all working circles without an acceptable management plan and where a standard plan will not be programmed for preparation by 1955, to prepare a simple stop-gap management plan for each such working circle by not later than December 31, 1951.

3. Each Region to program its timber management planning job so standard plans, which will be based on acceptable inventories will be completed for all working circles by 1960.

Regions to be expected to schedule time and funds to accomplish the above.

Bryan
Lindh
Hughes
Lund, Chairman

COMMENT - The recommended program for completion of the initial management planning job by 1960 is sound. Each Region should plan to use available funds to the end that this program can be accomplished.

The emphisis on management for the production of high quality timber is in line with Forest Service policy. Any exception to the general policy should be fully justified.

The responsibility for Washington Office leadership in the inventory - sampling - aerial surveys field is recognized.

For the present the requirement that management plans be approved by the Chief will be continued.

W.O. Committee

# REPORT OF SILVICULTURE COMMITTEE, NO. 2

1. We believe that long-term National Forest management should be geared toward the production of quality products. In that way the National Forests will make the greatest contribution to national security in peace or war. Furthermore, we believe that proper silvicultural practices can produce high quality without sacrificing quantity.

2. We believe that intensive silviculture should be concentrated on the best land first.

3. We believe that compositions characteristic of subclimax and climax associations should be used as guides for establishing silvicultural practices.

4. We believe that natural areas should be established in all forest types as an important means of increasing silvicultural knowledge. We also believe in expanding the use of demonstration areas.

5. We believe more silvicultural knowledge exists than is being applied in the woods today. We recommend that the experiment stations assemble silvical guides by regions or by types in a form that can be readily absorbed by field men. These guides would include abstracts of pertinent literature and summaries of research findings.

6. We believe that close on-the-ground cooperation between research silviculturists and administrators is essential and will work to the advantage of both.

7. We believe that silviculture can be improved in quality without increasing its intensity or its cost. To accomplish this there is no substitute for skillful men in the woods. To obtain these men, proper selection and training are of paramount importance.

8. We believe that greater emphasis should be given to the plans for the use of K-V funds because of their importance in obtaining desirable silvicultural practices.

9. We believe that cheaper logging methods and closer utilization, unless correlated with proper silviculture may boomerang and prove to be a menace to the forest.

10. We believe that the experiment stations should gather up available information and issue guide tables for optimum growing stock which, for most species, is considerably below the stocking used in normal yield tables. This information is needed in the preparation of management plans.

Cole
Tabbutt
Westveld
Zehngraff
Matthews, Chairman

COMMENTS: This report deals with basic silvicultural concepts and falls short of recommending specific practices, standards, or guides in management planning. The "don't fight nature" principle is overstressed. In many cases the real job of silviculture is to devise means of maintaining as high proportions of the desired species as possible in spite of trends toward the climax and to do this without undue cost or site deterioration.

Greater use of research knowledge and improved on-the-ground cooperation between Research and Administration is stressed. Administrative officers who have management plans to prepare, revise, or administer should take the initiative in extracting all pertinent information on their problems from researchers.

Optimum growing stock information for our many type and site combinations is indeed badly needed. Available information is scant. Regions should get from stations all available data, including estimations. Much more work is needed in many cases.

W.O. Committee

REPORT OF INVENTORIES, GROWTH AND YIELD COMMITTEE, NO. 3

On the basis of the papers presented and the discussion of them, your committee on inventories, growth, and yield submits the following recommendations:

1. Maps showing timber types, stand size classes, and density should be considered essential to planning and applying forest management. In some areas the mapping of site quality may be highly desirable in addition to the above classes, and in all-aged stands age class structure may be important.

2. Aerial photographs provide the most efficient and accurate basis for the preparation of cover maps showing stand size class, age structure density, and in many areas type and site also. Whatever ground mapping is done is facilitated by the use of aerial pictures. To accomplish effective mapping, the pictures should be up-to-date to the extent that the present classification of at least 90 percent of the area can be determined, and the scale should usually be not smaller than 4 inches to the mile. Where hardwoods and conifers occur in mixture or as intermingling pure types, modified infra-red photography is recommended.

3. Estimates of growth, mortality, and changes in stand structure can best be obtained from permanent sample plots. In setting up the sampling scheme, full use should be made of experience and data available from Forest Management Research and Forest Survey. Use of the method of optimum allocation of plots to mapped classes should be considered with reference to the most important variable being estimated, whether volume, growth, or the monetary value of volume or growth. The sample should provide unbiased estimates for each condition class with the allowable range of sampling error set at the maximum that can be tolerated without affecting the major provisions in the management plan.

In even-aged stands, such as Douglas-fir in Region 6 and western white pine in Region 1, it may be desirable to express permanent plot results in the form of empirical yield tables, adjusted periodically by remeasurement of plots, and including both yield and mortality data.

4. Pending the first remeasurement of permanent plots, growth predictions should be based on existing procedures, such as yield tables, Forest Survey estimates, and prediction equations.

5. The use of machine tabulating equipment in compiling permanent plot data should be fully explored to determine whether or not it is more efficient in the long run than hand tabulation.

6. Full use should be made of regression methods in the planning, collection and use of permanent plot data, in order either to reduce the sampling error of estimates or, in planning surveys, obtain a given accuracy with the least effort.

7. Your committee recognizes the value of aerial photography and the application of modern statistical techniques in the collection of management plan data. In order that all regions may keep abreast of these important fields, it is recommended that the Washington Office serve as a clearing house and provide guidance in the use of new techniques and methods in these fields.

Sump
Wheeler
Hasel, Chairman

COMMENT: These recommendations call for a high degree of technical performance designed to aid in reaching our sustained yield objective at lowest cost consistent with the procurement of adequate data of known reliability.

W. O. Committee

REPORT OF REGULATION OF CUT, CUTTING BUDGET, CUTTING PLANS COMMITTEE, NO. 4

1. Regulation of the cut is the essence of the timber management plan. It is the scheduling of the rate and volume of the regeneration and intermediate cuttings to meet the management objectives for the working circle. These objectives include the following:

1. To provide a sustained flow of timber products.
2. To obtain a balanced distribution of age classes or size classes as quickly as practicable.
3. To obtain maximum yields.

2. Until the second objective is attained, some temporary sacrifices will have to be made in maximum yields if a sustained flow of products is to be provided. In accordance with the provisions of Regulation S-3, the management plan must establish the maximum periodic allowable cut. Standardization of methods for the determination of the allowable cut is not recommended. The methods used must be flexible to fit the variations in stands encountered and silvicultural systems employed, but in all cases both volume and area checks should be made. The need for separate regulation by species, forest types, or products should be reviewed and appropriate controls provided, working circle by working circle.

3. Regulation of cut is expressed in the cutting budget. The cutting budget lists the amount and location of the timber which it is intended to cut for a period of 5 to 20 years after which the cutting budget is to be revised. The annual cut may vary from the periodic annual allowable cut but the established maximum periodic allowable cut should not be exceeded without approval by the Chief. It is recommended that the following cutting budget revisions may be made with the approval of the Forest Supervisor:

1. Change in the order of cutting of the budgeted timber.
2. Substitution of unbudgeted timber for budgeted timber.

Krueger
Briegleb
Lane
Streinz , Chairman

COMMENT: This statement is technically sound, but it omits specific reference to the need for regulation of the growing stock. In most National Forest working circles there always will be problems of reduction of excess growing stock or increase of deficient growing stock. Chief problem on many working circles is to determine, and work toward, optimum growing stock--species composition and volume both are involved. Both regulation and silviculture should be pointed toward development of optimum growing stock as the basis for maximum yields of quality products.

Some flexibility, usually by 5-year periods, must be written into the cutting budget. Some regions may wish to hold authority in regional office for substitution of unbudgeted areas and volumes for budgeted items, rather than extending blanket authority to the supervisor, as recommended by the committee.

W.O. Committee

REPORT OF MANAGEMENT PLAN COMMITTEE, NO. 5

1. Management plans are needed and should be prepared at the earliest possible time for every National Forest working circle in which timber harvesting operations are in progress or in immediate prospect.

2. To accomplish the necessary planning with the least possible delay, the committee believes that the work should proceed and that planners should use the best resources data and social and economic information now at hand. We feel, however, that a planned and conscious effort should be made to continuously improve the factual data upon which the plan is founded.

3. We believe that basically a timber management plan should be a plan for the management of the timber resource and not a general resource management plan. It should include only data and discussions which have a direct bearing upon the prescriptions for the management of timber in the working circle in question.

4. It is the consensus of this committee that except in unusual cases the process of development of a management plan be divided into two separate and distinct parts:

The first would be applicable to an entire National Forest or groups of working circles in which similar conditions prevail, and would include such items as social and economic aspects of the timber management progra generally applicable silvicultural prescriptions; physiographic features; climate; correlation with other legitimate National Forest uses; planting, timber stand improvement, and fire control policies; etc. In brief, we believe that this section of the management plan should treat those aspect of timber management planning which are common to a group of like working circles; or an individual National Forest.

The second part of the plan would deal with the technical phases of management for an individual working circle included in the group covered by the foregoing general discussion. It should include specific resource data, sustained yield calculations, and provisions for the regulation of cut. It should include also a discussion of any deviations from general resource management programs or policies established in the general section of the plan and should contain an action program for the guidance of the on-the-ground manager of the timber resource.

5. The committee believes that to instrument the foregoing program a comprehensive outline or check list should be prepared from which management plan writers could select items believed to be pertinent and appropriate for discussion in each of the two separate parts of the plan. Strict standardization of plans is felt to be undesirable and unwarranted.

6. It is the belief of the committee that management plans prepared in the form indicated above should be developed as follows:

The supervisor and his staff, with assistance from the Regional Office if desired and needed, should assume leadership in the preparation of the general section of the plan. The second or technical phase of the plan should be prepared and maintained by the district ranger or at least with his full participation.

7. This committee has been specifically asked to state its views of the term "cutting budget." We agree with the definition of the term implied by Gross' discussion of the subject appearing on pages 55 and 56 of the review edition of "Management Plans on the National Forests." We feel, however, that if cutting budgets as thus defined are incorporated in management plans, full latitude should be provided for changing both the location and volume of planned cutting as the exigencies of the situation may demand--provided of course that the sustained yield concept is not violated.

8. Transportation problems vary extremely from one section of the country to another insofar as they bear upon the management of the National Forest timber resource. We feel that it is inappropriate therefore to recommend standard treatment for road and transportation consideration in the management planning process. In all working circles where proper utilization of the timber resource is dependent upon the

development of transportation facilities, the planning of these developments should be provided for in the timber management plan unless transportation planning of an adequate nature has been done separately. The decision as to whether transportation planning should be a part of the general phase or of the technical phase of the timber management plan will have to be made locally to best suit the situation.

9. The exact nature of control records needed for the proper management of the National Forest timber resource will vary widely from region to region. It is the consensus of the committee, therefore, that wide latitude in designing control records should be allowed. It is the feeling of this committee further that it is immaterial whether the control records are made an integral part of the technical section of the management plan or whether their nature and extent is specified within the management plan with the requirement that they be maintained as a separate document.

Grossenbach
Cook
Meagher
Kirkpatrick, Chairman

<u>COMMENT</u>: This is a realistic approach to the management planning job. Particular emphasis is due the recommendation for 2-part plans. This should aid coordination, reduce duplication, and speed up the job of plan preparation.

The management plan conference is a useful, and sometimes essential, step in planning the plan. Regional Office partici-pation and leadership often will be desirable.

Control records show accomplishment of management plan prescriptions and, therefore, are an integral part of the plan, even though maintained separately. The form of control records should be standardized by each region.

W.O. Committee

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

3-16-49

Management Plan Conference

Topic 2 - The Management Plan Situation

L. S. Gross
Timber Management, Chief's Office

Why management plans? Each national forest working circle needs a management plan to insure continuity of sustained yield management of its productive timber lands. Timber is a long term crop, foresters come and go. We cannot meet Forest Service policy of "sustained yield, working circle by working circle" nor manage the national forests "to furnish a continuous supply of timber for the use and necessities of citizens of the United States," without some means of coordinating and continuing a program of timber cutting geared to the productivity of the soil. The management plan should do so.

A Look at the Past

The need for management plans was recognized even before the Forest Service was created. The report of the Forester for 1902 discussed the problem and what was being done about it.

> "The preparation of working plans for the National forest reserves is one of the urgent pieces of work before the Bureau. It has arisen from the request upon the Secretary of Agriculture from the Secretary of the Interior for advice as to the best management of the reserves, which now comprise a total area of 58,850,925 acres. The study on the ground necessary to a working plan was carried on during the past year in the Prescott Forest Reserve, Arizona, which contains 423,680 acres, the Priest River Forest Reserve, in Idaho, with an area of 645,120 acres and the Big Horn Forest Reserve, in Montana, which includes 1,216,960 acres. The field work in the Prescott Reserve occupied a party of 11 men for three months. Measurements of the stand were taken upon 1,648 acres, and 1,840 measurements were made of volume and rate of growth; the Bull Pine was carefully studied, particularly with reference to the effect of the present methods of lumbering upon the reproduction of the tree, and the data were obtained for a comprehensive plan for the best management of the reserve with due regard to its value in the production of timber and in maintaining the water supply. The field work carried on in the Big Horn Reserve occupied a party of 7 men a period of four

(Over)

months. The stand was measured on 820 acres, and 1,299 measurements made upon felled trees. In the Priest River Reserve a party of 6 men were at work for three months. The stand was measured upon 879 acres, and 720 measurements of volume and rate of growth were made.

"A thorough preliminary examination preparatory to a working plan is now being made of the San Francisco Mountains Forest Reserve, in Arizona."

In Volume X, Proceedings of the Society of American Foresters, July 1915 issue, Barrington Moore describes the period 1905-1911 as one of rapid change and of experimentation in the making of plans. He says in part:

"Conditions peculiar to America make this experimentation a necessary part of the normal growth of plans. These conditions fall under two main heads: (1) The large size of the areas to be managed. This controls the character of the feasible operations, preventing altogether much that on smaller areas is considered essential, and modifying the rest. (2) Economic conditions, in particular the undeveloped nature of much of the territory containing the National Forests, combined with the rapid but by no means uniform development of this territory.

- - - - - - - - - - - - - - - - - - - - - - - - - - -

"Methods of management based on calculations of requirements for only a few years to come are liable to be badly disturbed by radical changes in these requirements. It has therefore been due to conditions, as well as to development in ideas, that plans have required revision almost as soon as they had been written.

"In spite of these conditions, the main idea of European plans, regulation of the cut, persisted to a great extent in American plans and gave rise to considerable trouble. The Indian idea of including forest description, or silvics, and silviculture was also introduced in some places; but the conception of a working plan as consisting solely of regulation of the cut was, however, so strong that among many foresters the terms working plan and regulation of cut were synonymous. Where sustained yield was for the time impossible, and this was and still is the case on many National Forests, plans were often considered impossible.

"This should not be taken as condemnation of regulation of the cut in working plans; regulation is extremely desirable where feasible, and must eventually be applied universally. Plans can and should exist without detailed hard and fast provisions for sustained yield until such time as sustained yield becomes possible. At the same time the best available approximation of the yield of the forest should be given, even though it need not be adhered to, so that it will be possible to tell roughly the amount of the undercut or overcut.

"There is another important condition which must be realized before the development of government working plans or forest plans can be understood. This is the relation between the plan and the management of the forest. The actual work of handling the forest received first attention, as it quite properly should, and the plan followed in the wake of this work rather than leading it.

---

"Protection against fire was the first and foremost need, calling for trails, telephone lines, ranger cabins, etc. in hitherto inaccessible mountains. Grazing lands must be utilized and timber sold. To do this without injuring the forage crop or destroying the forest required adequate supervision. Although the work on which the growth of plans depends was being done, nobody had time to think of writing plans."

The Regions (Districts then) were organized in December 1908. Prior to that time all national forest activities were centralized in Washington. Organizing of the Regions decentralized the work of timber surveys and management plan preparation. A lot of effort was devoted to management planning, particularly in those areas where market conditions were favorable and there was an immediate demand for national forest timber. In the annual report of the Forester for 1912, progress is summarized. In those early days demand for national forest timber - and hence the urge to prepare management plans - was most accentuated in areas of good accessibility and where there was not much private timber available. The 1912 report records:

"The collection of the detailed data for working plans is carried on under the immediate direction of the supervisors, with inspection and supervision from the district offices and Washington. Completed plans are finally reviewed by the assistant foresters in charge of each branch, and approved by the Forester.

> "Preliminary plans are being prepared as rapidly as practicable for all forests except those on which working plans are needed. Working plans are now in preparation for the following forests: The Kaniksu, where the demand for western white pine has become very great, and sales are desirable to permit the listing of agricultural lands; the Deerlodge, on which there is a very extensive demand for timber to supply the Butte mines; the Crook, where approximately the total production of the forest is and will be needed to supply the needs of settlers in and near the forest; the Coconino and Tusayan, where there has been for a number of years an extensive demand for yellow-pine timber for the general market; the Gila, where a strong demand has existed for fuel wood to supply the mines at Mogollon; the Plumas, from which it will be possible to dispose of a large part of the annual production to supply the general market; the Medicine Bow, with a large amount of material suitable for railroad ties, which in the future are practically certain to be in great demand for railroad maintenance and extension; and the Florida, where an active naval stores industry is ready to utilize the entire turpentine yield of the forest that can be made available."

We still have with us some of the problems which faced foresters 30 or 40 years ago. In Moore's 1915 article he discussed at some length the argument that virgin stands on the National Forests should be cut over as rapidly as possible. He pointed out that those who advocate rapid liquidation of old growth timber overlook the fact that heavy volumes occur on a relatively small percentage of the total area, that the rate of deterioration of these old stands is exaggerated by the proponents of rapid liquidation, that there would be future need for high quality stumpage which could not be obtained from second growth stands. Some recent spectacularly high bids for high quality old growth timber bear out his contentions.

Moore apparently advocated our present concept of "sustained yield, working circle by working circle." He opposed a tendency to rationalize over-cutting accessible stands by extending working circle boundaries to include two or more national forests in one working circle, even though there seemed little likelihood that the "back country" areas would prove to be operable under existing conditions.

Thus it seems that some of our present day management plan problems are not new - maybe they are chronic.

Development of National Forest Timber Cut

By 1915 the cut of national forest timber had climbed to about half a billion feet. The increased timber demands incident to and following World War I raised the total to about eight-tenths of a billion in 1920 and to a billion feet in 1925.

Added emphasis was given to the need for preparation of timber policy statements and management plans at the Cooley Conference in 1922. One result of Cooley was the preparation in 1928 of Eldredge's USDA Miscellaneous Publication No. 11 "Management Plans with Special Reference to the National Forests." This bulletin - long since out of print - remains the only published official Forest Service word on the subject.

The need for more and better timber management plans continued to increase as the cut climbed to 1.6 billion feet in 1930, receded during the depression, reached 1.7 billion in 1940. Again under the stimulus of war and post-war demands, the total national forest cut exceeded 3 billion feet in 1945, reached 3-3/4 billion in 1948, and may break 4 billion feet in 1949. Total cut this year is more than double the cut 10 years ago. Another 50% increase - to 6 billion feet - will bring us to estimated "present" sustained yield capacity. Now that we are this far along toward sustained yield for the national forests as a whole, we can't afford to be very much wrong in very many places. We need to be sure of what we are doing on each working circle.

Management Plan Preparation

It is difficult to write management plans, and harder yet to prepare plans which actually are worth their cost. Lots of men have talked and written about the problem. In 1914 Joe Kircher stated six reasons why management plans had failed.

"1. They are long reports, and largely silvical.

"2. They give in detail unimportant considerations and often slight important ones. (Good silviculture)

"3. They fail to take local and American conditions into consideration. (Accessibility)

"4. They are too academic.

"5. They attempt to regulate the yield by scientific and mathematical principles, based on insufficient data without reference to local conditions.

"6. They are not practical."

Many of us have expressed somewhat similar opinions of some more recent plans. Yet there are some working circles for which the original plans written 20 or 30 years ago - revised to fit changing conditions - have served well to guide and direct management. For example, Eagleton Working Circle here on the Ouachita National Forest. The first management plan was approved in 1921. Successive revisions in 1926, 1938, 1942, and 1946 have resulted in marked changes, have kept the plan current.

Another example of continuity is the Flagstaff Working Circle, Coconino National Forest. This includes the "San Francisco Peaks Area" mentioned in the passage I quoted from the Forester's 1902 report. A plan was drafted in 1911. Professor Chapman wrote the first real plan in 1919 - 30 years ago. Chapman's plan established sustained yield. Changing economic conditions, better inventory data and improved silvicultural practices - resulting from research - have caused a number of revisions. One example of change is the reduction of the length of the cutting cycle. 100 years in 1919. 20 years in 1947.

There was a great deal of activity in management plan preparation following the Cooley conference and again during CCC days. Many of our approved policy statements and management plans were written in the 20's, many more in the 30's. You know how they have worked - how useful they have been. Maybe we share Joe Kircher's opinion regarding many of them.

Perhaps the chief lessons for us in this review of the record of study and accomplishment in the management plan field are:

1. Management plans should be written when needed - not too long ahead of actual need.

2. Each plan must be practical.

3. Plans always will be subject to revision as conditions change.

We have plenty of background in management plan preparation and use. We have a big job ahead of us. It is imperative that we get on top of the management plan job. What that job is, what we are doing about it, and what should be done, will be developed in the next discussion. Before we complete this Conference we should agree <u>how</u> to do the job. The other big problem involves financing. We should be able to estimate the cost, and, I hope, arrive at sound recommendations on methods of paying the bill.

# TOPIC 3
# TIMBER MANAGEMENT PLAN NEEDS AND PROGRAMS
## Region One

### Summary

| | Number | Acres |
|---|---|---|
| Approved plans less than 5 years old | 1 | 1,211,000 |
| Plans being written | 3 | 473,694 |
| Other plans started | 15 | 3,744,000 |
| Other working circles | 57 | 7,563,502 |
| Total | 76 | 12,992,196 |

### Estimated cost of preparing management plans

| | | |
|---|---|---|
| Surveys | $0.10 | per acre |
| Plan preparation | .04 | per acre |
| Total cost | $0.14 | per acre |

The cost of maintenance with a revision at 5-year intervals is estimated to average one-half cent per acre per year.

There is an urgent need for the preparation of management plans for at least 50 percent of the region's working circles within 5 years. These plans should be reviewed and if necessary revised every 5 years.

| Forest and working circle | Commercial forest land (NF) available for management | Average annual cut Past 5 years | Average annual cut Next 5 years | Allowable annual cut | Date of approved plan | New plan W-written S-started and year will be completed |
|---|---|---|---|---|---|---|
| | Acres | MBF | MBF | MBF | Year | Year |
| Clearwater | | | | | | |
| Pierce | 98,024 | 15,000 | 20,000 | 26,000 | - | W-1949 |
| Canyon | 226,807 | 6,000 | 15,000 | 50,000 | - | |
| Kelly Creek | 57,510 | 0 | 6,000 | 10,000 | - | |
| Lochsa | 64,157 | 0 | 0 | not set | - | |
| North Fork Area | 10,675 | 0 | 2,000 | 2,000 | - | |
| All | 457,173 | 21,000 | 43,000 | 88,000 | | |
| Coeur d'Alene | | | | | | |
| Coeur d'Alene | 661,000 | 55,000 | 63,000 | 75,000 | 1936 | |
| Kaniksu | | | | | | |
| Priest River | 294,000 | 18,500 | 18,000 | 27,500 | 1927 | |
| Bonners Ferry | 347,000 | 15,000 | 14,000 | 17,500 | 1929 | |
| Pend Oreille | 328,000 | 10,500 | 20,000 | 12,000 | 1929 | |
| Sandpoint | 290,000 | 4,000 | 6,000 | 11,500 | - | |
| All | 1,259,000 | 48,000 | 58,000 | 68,500 | | |
| St. Joe | | | | | | |
| Fishhook | 140,422 | 4,840 | 10,000 | 14,000 | - | S-1949 |
| Upper St. Joe | 134,820 | 0 | 5,000 | 12,700 | - | S-1949 |
| Lower St. Joe | 211,914 | 1,000 | 5,000 | 4,700 | - | S-1949 |
| St. Maries | 77,669 | 3,530 | 5,200 | 5,200 | - | S-1949 |
| Potlatch | 132,957 | 7,640 | 9,800 | 9,800 | - | S-1949 |
| L. N. Fork Clearwater River | 58,775 | 130 | 3,000 | 7,800 | - | S-1949 |
| All | 756,557 | 17,140 | 38,000 | 54,200 | | |
| Total (White Pine Forests) | 3,133,730 | 141,140 | 202,000 | 285,700 | | |

| Forest and working circle | Commercial forest land (NF) available for management | Average annual cut | | Allowable annual cut | Date of approved plan | New plan W-written S-started and year will be completed |
|---|---|---|---|---|---|---|
| | | Past 5 years | Next 5 years | | | |
| | Acres | MBF | MBF | MBF | Year | Year |
| Cabinet | | | | | | |
| Sanders County | 501,000 | 4,110 | 12,000 | 18,000 | - | S-1950 |
| St. Regis | 170,000 | 4,827 | 4,000 | 6,000 | - | W-1949 |
| All | 671,000 | 8,937 | 16,000 | 24,000 | | |
| Colville | | | | | | |
| Curlew | 72,170 | 959 | 3,000 | 3,374 | - | |
| Colville | 150,892 | 2,560 | 2,000 | 2,700 | - | |
| Kettle Falls | 246,825 | 6,922 | 6,000 | 6,577 | - | |
| Republic | 143,784 | 2,763 | 5,700 | 5,700 | - | |
| All | 613,671 | 13,204 | 16,700 | 18,351 | | |
| Kootenai | | | | | | |
| Libby-Troy | 1,211,000 | 36,000 | 56,000 | 69,000 | 1947 | |
| Tobacco River | 205,670 | 7,605 | 11,000 | 15,000 | - | W-1949 |
| All | 1,416,670 | 43,605 | 67,000 | 84,000 | | |
| Nezperce | | | | | | |
| Middle Fork | 523,212 | 2,000 | 12,000 | 24,000 | - | S-1949 |
| South Fork Clearwater River | 469,785 | 20,000 | 38,000 | 47,000 | - | S-1949 |
| Salmon River | 444,298 | 7,000 | 15,000 | 58,000 | - | S-1949 |
| All | 1,437,295 | 29,000 | 65,000 | 129,000 | | |
| Total (Western Forests) | 4,138,636 | 94,746 | 164,700 | 255,351 | | |

| Forest and working circle | Commercial forest land (NF) available for management | Average annual cut: Past 5 years | Average annual cut: Next 5 years | Allowable annual cut | Date of approved plan | New plan W-written S-started and year will be completed |
|---|---|---|---|---|---|---|
| | Acres | MBF | MBF | MBF | Year | Year |
| Bitterroot | | | | | | |
| Bitterroot | 495,303 | 17,571 | 20,000 | 25,000 | 1941 | |
| | | | | | | |
| Deerlodge | | | | | | |
| Philipsburg | 242,241 | 2,900 | 5,800 | 10,000 | - | |
| Deerlodge | 83,788 | 550 | 1,000 | 2,900 | - | |
| Anaconda | 33,217 | 1,750 | 2,000 | 2,250 | - | |
| Butte | 118,545 | 360 | 500 | 3,300 | - | |
| Boulder | 47,065 | 1,400 | 1,500 | 3,550 | - | |
| Whitehall | 105,000 | 760 | 500 | 1,900 | - | |
| All | 629,856 | 7,720 | 11,300 | 23,900 | | |
| | | | | | | |
| Flathead | | | | | | |
| Swan Valley | 154,901 | 3,367 | 6,000 | 11,580 | - | |
| Stillwater | 251,954 | 7,450 | 8,000 | 9,500 | - | S-1950 |
| North Fork | 190,021 | 3,746 | 11,000 | 13,000 | - | S-1949 |
| South Fork | 443,975 | 12,200 | 13,320 | 24,000 | - | |
| All | 1,040,851 | 26,763 | 38,320 | 58,080 | | |
| | | | | | | |
| Lolo | | | | | | |
| Superior-Ninemile | 379,688 | 3,120 | 5,000 | 12,000 | - | S-1949 |
| Lolo | 97,057 | 4,374 | 3,000 | 3,500 | - | |
| Seeley Lake | 94,963 | 1,346 | 3,000 | 4,689 | - | |
| Missoula-Bonita | 194,043 | 1,729 | 2,000 | 6,500 | - | |
| Powell | 50,752 | 84 | 100 | 9,500 | - | |
| North Fork Blackfoot | 42,482 | 0 | 2,400 | 2,020 | - | |
| All | 858,985 | 10,653 | 15,500 | 38,209 | (PS--1926) | |
| | | | | | | |
| Total (Western Montana Forests) | 3,024,995 | 62,707 | 85,120 | 145,189 | | |

| Forest and working circle | Commercial forest land (NF) available for management | Average annual cut: Past 5 years | Average annual cut: Next 5 years | Allow-able annual cut | Date of approved plan | New plan W-written S-started and year will be completed |
|---|---|---|---|---|---|---|
| | Acres | MBF | MBF | MBF | Year | Year |
| Beaverhead | | | | | | |
| Big Hole | 575,000 | 2,000 | 2,000 | 7,800 | - | |
| Beaverhead | 235,000 | 2,000 | 1,500 | 3,250 | - | |
| Ruby | 90,000 | 200 | 300 | 1,333 | - | |
| Madison | 185,000 | 1,000 | 1,000 | 2,500 | - | |
| All | 1,085,000 | 5,200 | 4,800 | 14,883 | | |
| Custer | | | | | | |
| Beartooth | 50,000 | 200 | 250 | 250 | - | |
| Ashland | 40,000 | 150 | 250 | 400 | 1921 | |
| Fort Howes | 50,000 | 300 | 350 | 600 | 1921 | |
| Ekalaka | 13,000 | 400 | 250 | 250 | 1920 | |
| Long Pines | 33,000 | 450 | 550 | 550 | 1920 | |
| All | 186,000 | 1,500 | 1,650 | 2,050 | | |
| Gallatin | | | | | | |
| Madison Basin | 97,870 | 4,165 | 6,000 | 6,500 | - | |
| Cooke | 9,040 | 12 | 25 | 250 | - | |
| Shields | 33,800 | 525 | 1,200 | 1,400 | - | |
| Yellowstone | 121,400 | 768 | 1,400 | 2,800 | - | |
| Big Timber | 58,825 | 544 | 600 | 2,000 | - | |
| Gallatin | 127,485 | 4,276 | 9,000 | 11,000 | - | S-1950 |
| All | 448,420 | 10,290 | 18,225 | 23,950 | | |
| Helena | | | | | | |
| Canyon Ferry | 13,800 | 920 | 3,000 | 3,000 | - | |
| Smith River | 7,500 | 50 | 380 | 750 | - | |
| Helena | 70,000 | 688 | 700 | 1,500 | - | |
| Lincoln | 17,000 | 55 | 1,000 | 3,500 | - | |
| Townsend | 14,610 | 321 | 210 | 648 | - | |
| Little Blackfoot | 37,100 | 244 | 1,100 | 1,500 | - | |
| All | 160,010 | 2,278 | 6,390 | 10,898 | | |
| Lewis & Clark | | | | | | |
| Highwood | 15,725 | 24 | 20 | 20 | - | |
| Judith River | 106,695 | 220 | 3,500 | 7,258 | - | |
| Musselshell | 121,800 | 770 | 1,500 | 1,400 | - | |
| White Sulphur Springs | 100,000 | 4,049 | 9,000 | 7,800 | - | S-1949 |
| Dearborn | 48,070 | 20 | 30 | 200 | - | |
| Sun River | 72,325 | 50 | 80 | 395 | - | |
| Little Rockies | 21,125 | 13 | 15 | 70 | 1925 | |
| Belt Creek | 155,500 | 274 | 1,200 | 3,160 | - | |
| Teton | 37,095 | 200 | 350 | 991 | - | |
| Snowy Mountains | 42,665 | 215 | 150 | 895 | - | |
| Marias | 94,405 | Negl. | Negl. | 878 | - | |
| All | 815,405 | 5,835 | 15,845 | 23,067 | | |
| Total (Eastern Montana Forests) | 2,694,835 | 25,103 | 46,910 | 74,848 | | |

| | Commercial forest land (NF) available for management | Average annual cut | | Allowable annual cut |
|---|---|---|---|---|
| | | Past 5 years | Next 5 years | |
| | Acres | MBF | MBF | MBF |
| Western forests | 4,138,636 | 94,746 | 164,700 | 255,351 |
| White pine forests | 3,133,730 | 141,140 | 202,000 | 285,700 |
| Western Montana forests | 3,024,995 | 62,707 | 85,120 | 145,189 |
| Eastern Montana forests | 2,694,835 | 25,103 | 46,910 | 74,848 |
| Regional total | 12,992,196 | 323,696 | 498,730 | 761,088 |

S
PLANS
Timber Management

# STATUS OF PLANS FOR MANAGEMENT OF

# NATIONAL FOREST TIMBER

## SUMMARY

__________ Working Circle        __________ National Forest

Nonnational Forest Commercial Forest Lands in or tributary to this working circle:

1. Area __________ acres, suitable for management.
2. Total volume now available __________ M ft. B.M.
3. Average annual cut past 5 years __________ M ft. B.M.
4. Anticipated annual cut next 5 years __________ M ft. B.M.

National Forest Commercial Forest Land in this working circle:

5. Area __________ acres, available for management.
6. Allowable annual cut __________ M ft. B.M.
7. Average annual cut past 5 years __________ M ft. B.M.
8. Anticipated annual cut next 5 years __________ M ft. B.M.
9. Status of plans for management of national forest timber:

__________________________________________

__________________________________________

10. Principal Recommendation: __________________________

__________________________________________

__________________________________________

Prepared by ______________________________

Date ______________________________

Approved by ______________________________
Forest Supervisor

Date ______________________________

M-1095-R1, Sheet 1

## SUMMARY
## Instructions

This is the first or cover sheet of the report.

1. Item 6, sheet 2, nonnational forest net commercial forest land suitable and available for management.

2. Based on item 6(a) and 6(b), sheet 2, the work sheets for item 6 will show estimated acreages. Where there is no better method of obtaining the volume of saw timber it can be approximated by applying volume per acre averages to the estimated acreages.

3. Item 4(b), sheet 3.

4. Base on item 4(b), sheet 3, items on sheet 5, mill capacity, market outlook, knowledge of local factors, etc.

5. Item 6, sheet 2, national forest net commercial forest land suitable and available for management.

6. Item 1, sheet 5, use the total in which poles, pulpwood, etc., are converted to board feet.

7. Item 4(a), sheet 3.

8. Base on items 4 and 5, sheet 5 and judgment of other factors.

9. Give name and date of last plan or policy statement for the working circle. If there is no plan or policy statement for the working circle, simply state that fact.

10. Principal recommendation with respect to the preparation of a management plan for the working circle. Indicate the date of completion and the priority on the forest. If none is needed, so state.

## PHYSICAL FACTS

1. Location - Principal drainages: ____________________

2. Counties: ________ County ____% ________ County ____%
   ________ County ____% ________ County ____%

3. Ranger Districts: ________ District ____% ________ District ____%
   ________ District ____% ________ District ____%

4. National Forests: ________ N.F. ____% ________ N.F. ____%

| | National Forest | | Nonnational Forest | | Total | |
|---|---|---|---|---|---|---|
| 5. Gross area forest land: | ____ Acres | ____% | ____ Acres | ____% | ____ Acres | 100% |
| 6. Net Commercial Forest Land Suitable and Available for Management: | ____ Acres | ____% | ____ Acres | ____% | ____ Acres | 100% |

Condition (percentages by area):

| | National Forest | Nonnational Forest | Total |
|---|---|---|---|
| (a) Overripe saw timber | ____% | ____% | ____% |
| (b) Saw timber | ____% | ____% | ____% |
| (c) Poles | ____% | ____% | ____% |
| (d) Seedlings & Saplings | ____% | ____% | ____% |
| (e) Nonstocked | ____% | ____% | ____% |
| (f) Total | 100 % | 100 % | 100 % |

7. Principal Species:

| | | | | | |
|---|---|---|---|---|---|
| ________ | ____% | ________ | ____% | ________ | ____% |
| ________ | ____% | ________ | ____% | ________ | ____% |
| ________ | ____% | ________ | ____% | ________ | ____% |
| All other | ____% | All other | ____% | All other | ____% |
| Total | 100 % | Total | 100 % | Total | 100 % |

8. Principal owners by
   Size of holdings -
   Largest first: ____________________
   ____________________
   ____________________
   ____________________
   ____________________

9. Distance from common carrier railroad:

   Within 10 miles ________%
   Within 25 miles ________%
   Within 50 miles ________%

## PHYSICAL FACTS
### Instructions

1. List principal drainages - Upper Green River, Bear Creek and Ox Creek.

2. Show percentage distribution of the gross area included in the working circle by counties to nearest 5 or 10 percent. Indicate the state too if more than one is involved. The total should equal 100 percent.

3. Show percentage distribution of the gross area inside the national forest boundary in the working circle by ranger districts to nearest 5 or 10 percent. The total should equal 100 percent.

4. Same as 3 for national forests where more than one is involved.

5. First item in a table. Gross area of forest land within the exterior boundary of the working circle before any reductions are made for reservations. Therefore, not limited to lands inside the national forest boundary. Forest land includes all timber types as well as subalpine and nonreforested cut-overs and burns. Does not include agricultural land, barren, or water.

6. Net commercial forest land after subalpine and informal and formal reservations are taken out of 5 (see item 4 "Status of Timber Management Plans" for examples of informal and formal reservations). Open woodland types and areas of lowest site quality that will not produce saw timber as defined below should be excluded too.

6(a)(b) Saw timber - Stands in which more than 50 percent of the net cubic volume is in trees 11.0 inches DBH and larger and generally contain at least 3000 board feet per acre. Over-ripe saw timber shows excessive mortality or decay due to age, insects or disease.

6(c) Poles - Stands in which more than 50 percent of the net cubic volume is in trees 5.0 to 10.9 inches DBH.

6(d) Seedlings and saplings - Stands that are at least 10 percent stocked with trees below 5.0 inches DBH that contain more than 50 percent of the net cubic volume.

6(e) Nonstocked - Less than 10 percent stocked.

7. An estimate of the principal species in the saw timber stands.

8. Principal owners of the nonnational forest net commercial forest land suitable and available for management. Give acreages if available.

9. Rough approximation of the percentage of the gross area of the working circle that is, each distance from a common carrier railroad. The percentages are cumulative.

## SOCIAL AND ECONOMIC FACTS

1. Communities in Working Circle:

| Name | Population | Percent dependent upon forest products from working circle |
|---|---|---|
| ________ | ________ | ________ |
| ________ | ________ | ________ |
| ________ | ________ | ________ |
| ________ | ________ | ________ |
| ________ | ________ | ________ |

2. Mills Dependent on This Working Circle:

| Daily Capacity | Number of Mills |
|---|---|
| Over 50,000 | ________ |
| 25,000-50,000 | ________ |
| 11,000-24,000 | ________ |
| 10,000-or less | ________ |
| Other plants | ________ |

3. Volume cut from national forest lands in working circle by years for past 10 years: (millions of board feet.)

| | | | |
|---|---|---|---|
| 1939 | ________ | 1944 | ________ |
| 1940 | ________ | 1945 | ________ |
| 1941 | ________ | 1946 | ________ |
| 1942 | ________ | 1947 | ________ |
| 1943 | ________ | 1948 | ________ |

4. Average annual cut past 5 years: (millions of board feet.)

(a) From N. F. lands ________ percent milled in W. C. ________%

(b) From other lands ________ percent milled in W. C. ________%

5. Other pertinent facts; markets, other industries, etc:

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

M-1095-R1, Sheet 3

## SOCIAL AND ECONOMIC FACTS
### Instructions

1. Use 1940 census if no more recent population figures are available. Estimate dependence to nearest 10 percent.

2. List only the mills that get over 50 percent of their raw material from the working circle. (From the gross area of the working circle.) Under other plants include pole plants, mine timber plants, shingle mills, etc. Prepare a list of plants to go with Overlay A.

3. Can be obtained from timber sale records. Convert poles, pulpwood, etc., to board feet.

4. (a) Obtained from 3 above. Estimate percent milled inside the working circle to the nearest 10 percent.

   (b) Amount cut on other lands will have to be an approximation based on mill capacities and number of days worked per year. Use a work sheet and preserve it.

5. The proportion of the cut that is consumed in the working circle is significant or if most of it is shipped to distant markets, that should be noted. Other items that might be mentioned are alternative opportunities for labor and capital in the working circle in agriculture, mining, etc., in case forest industries shrink. Any local pressure for allocation of national forest timber to local industries should be noted. Also note evidence of interest in sustained yield management.

## STATUS OF TIMBER MANAGEMENT PLANS

1. Existing management plans or policy statements:

______________________________________________
______________________________________________
______________________________________________
______________________________________________

2. List of intensive cruises in working circle: (minimum area 640 acres)

| Location | Acreage | Percent of Cruise | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

(attach extra sheet if necessary)

3. List sources of information for extensive coverage of working circle:

______________________________________________
______________________________________________
______________________________________________
______________________________________________
______________________________________________

4. List of currently recognized or formally dedicated reservations affecting management of the working circle: (also show on a map or overlay)

______________________________________________
______________________________________________
______________________________________________
______________________________________________
______________________________________________
______________________________________________
______________________________________________

5. List current files having special bearing on management plans for this working circle:

______________________________________________
______________________________________________
______________________________________________

M-1095-R1, Sheet 4

# STATUS OF TIMBER MANAGEMENT PLANS
## Instructions

1. List current plans and policy statements by name and date of approval. If the plan has not been approved indicate status. Also indicate whether plan or policy statement applies to entire forest, entire working circle or part of the working circle.

2. An intensive cruise sampled 5 percent or more of the area.

   Cruises more than 20 years old are of doubtful value unless converting factors have been recently obtained.

3. The grazing survey and the forest survey will be the most common sources of information. Aerial photos may also prove to be useful. List the sources of information that proved to be most helpful in the preparation of this report.

4. Formally dedicated reservations include natural areas, primative areas, wilderness areas where approved by the Secretary, etc., but they do not include informal reservations such as roadside strips, campgrounds, etc. Show area of formal reservations if you can.

5. List inspection reports, letters or memos having pertinent statements bearing on the preparation of a management plan for the working circle. Give the gist of the statement as well as the designation and date. Also state who signed it.

## FUTURE POSSIBILITIES

1. ESTIMATED ALLOWABLE ANNUAL CUT of the national forest lands in the working circle:

   ______________ Million board feet, saw timber
   ______________ Poles by number, pulpwood by cords, etc.
   ______________ Total, million board feet (or board feet equivalent)

2. Estimated number of years nonnational forest timber in working circle will last at present rate of cutting: ______________

3. List mills or industries that appear destined to shut down in next 5 years unless they can obtain a supply of national forest timber from this working circle. Show annual capacities: ______________

4. Estimated demand for national forest stumpage by years (million board feet):

   1949 ________ 1952 ________
   1950 ________ 1953 ________
   1951 ________

5. Amount that can be sold with present roads (million board feet):

   1949 ______ 1950 ______ 1951 ______ 1952 ______ 1953 ____

6. List of additional roads needed in order of priority and their costs to meet estimated demand above (next 5 years):

7. List areas in need of cutting in order of priority with notes on volume, availability, and cost of selling: ______________

8. List of other high priority areas in order of priority with notes on volume, availability, and cost of selling: ______________

M-1095-R1, Sheet 5

FUTURE POSSIBILITIES
Instructions

1. A good method for computing the allowable cut will be found on page 25 of the mimeographed "Management Plan for the Kootenai Sustained Yield Unit" (1946). In essence this can be reduced to the formula:

$$C = \frac{V}{N}$$

C = allowable annual cut
V = volume in stands over rotation age that will be available for cutting (after taking out the "left" volume and making deductions for losses).
N = number of years in the adjustment period.

2. Estimate the total available saw timber stand on nonnational forest land in the working circle and divide by the average annual cut, based on item 4(b), sheet 3. One way to estimate the saw timber stand on these lands is to apply estimated per acre volumes to the area estimates used in estimating items 6(a) and 6(b), sheet 2. Preserve the work sheet.

3. Mills obtaining entire supply from a sale would be listed as shutting down at termination of present sale unless they have other sources of logs. Purpose is to show possible future dependence upon national forest timber.

4. If you prefer, estimate an average demand per year for next 5 years.

5& 6. Base estimate on common practice of the Forest Service in building access roads as well as common practice as to operator built roads.

7. Ripe saw timber areas are in need of cutting unless the losses have gone too far. List here only the ripe saw timber areas that it is practical to sell considering volume, accessibility and cost.

8. The purpose here is to show what it will take to meet the demand shown in 4 above.

The location of items 6-7-8 will be shown on Overlay B.
Use extra sheets for items 6-7-8 where necessary.

## POLICY RECOMMENDATIONS

Consider need for reconsidering or changing the boundaries of this working circle and make recommendations:

Recommend the priority for the preparation of a management plan of this working circle. It should be number ______ of the ____ working circles on the forest. Indicate the date the management plan should be completed:

Consider the need for land exchange and make recommendations:

Consider obstacles to selling the allowable cut in the working circle and make recommendations:

Consider the desirability or undesirability of making this working circle a federal or cooperative unit under Law 273 and make recommendations:

Make and explain any other recommendations applicable to this working circle:

## MAPS

Map of working circle, 1/4" scale. Make-up as a letter-size sheet if possible. Show boundary of working circle with a solid, heavy black line.

Make overlays on clear vellum with suitable binding as follows:

OVERLAY A Sawmills and other forest products, industries.

Legend Sawmills: (A) over 50,000 per day
(B) 25,000 - 50,000 per day
(C) 11,000 - 24,000 per day
(D) 10,000 or less per day
Other plants (W)

Prepare a list of plants tied to their symbols by number:
Star Pole Company (W)[5]

OVERLAY B Road system and future cutting areas.
Existing access roads (and connecting roads and highways) solid black lines.
Needed access roads, next 5 years, broken black lines.
National forest areas in need of cutting, solid red.
Other high priority areas, solid green.

OVERLAY C Intensive cruises. Minimum area 640 acres. Outline in black, use various colors to distinguish different areas and number to correspond to list in report.

OVERLAY D Principal reservations. Outline in black and number to correspond to list in report.

OVERLAY E (Optional) Area of national forest land cut-over in past 10 years. Outline each year's cut in black and use a different color for each year. Show year of cutting in black. Minimum area 160 acres.

S
PLANS - R-2
Timber Management

March 7, 1949

MANAGEMENT PLAN CONFERENCE - TOPIC #3

Timber Management Plan Needs and Program in Region 2

by Theodore Krueger.

The Forests in Region 2 have been divided into 83 Working Circles.

For purpose of planning the work in the Regional Office, we maintain a standard $18\frac{1}{2}$ x $21\frac{1}{2}$-inch binder, which contains a base map of each of the National Forests in the Region with Working Circle boundaries shown on the map. In addition, the binder contains a summary sheet showing the name of the Working Circle, date Management Plan or Policy Statement was prepared, date revised, date next revision is due, and allowable annual cut:

| Forest and Working Circle | Date Plan: or Policy: Statement: Prepared | Date Revised | Revision due 1948 | Revision due 1949 | Revision due 1950, etc. | Allowable Annual Cut M ft.b.m. | Remarks |
|---|---|---|---|---|---|---|---|

This provides a quick reference summary when the annual program of work for the Region is prepared.

As of January 1, 1949, Plans or Policy Statements ~~for the less important Circles~~ have been prepared for 66 Working Circles, leaving 17 Working Circles for which we do not have a Management Plan or Policy Statement. Of the 66 Plans, 33 with an acreage of 4,387,000 acres are satisfactory for our use.

For the calendar year 1949 we have included the following in our program of work:

| | |
|---|---|
| Revise existing plans | 4 |
| Prepare plans for Working Circles now without plan | 6 |
| | 10 |

Due to lack of good basic information on volumes, acreage, and growth, many of our present plans are weak, but we hope that within the next 10-year period, as better information is collected or business increases, we will be able to prepare adequate (not elaborate) plans for each of the Working Circles in the Region and then be able to meet revision dates as they come due. We will have to work on the basis of gradual growth or development of plans as revisions are needed. As additional facts are available, they should be used; as conditions change, they should be met.

Our special need for accomplishing our objective is aerial photos to cover the Forests in the Region in order that we might get correct condition class maps and volumes.

The estimated costs of preparing Management Plans vary according to topography, size of Working Circle, complexity of problems, types of timber, availability of growth data, whether or not aerial photos and ground control are available, and other factors, but the actual Management Plan work, exclusive of aerial photography, control, and timber survey, is about 1¢ per acre.

## WORKING CIRCLE INFORMATION
### Region 2

| Working Circle | Commercial Forest: Acreage M Acres | Commercial Forest: Timber Volume M ft. b.m. | Allowable Annual Cut M ft. b.m. | Acres Planned to Cut Annually | Date Plan Approved | Notes |
|---|---|---|---|---|---|---|
| Colorado | | | | | | |
| Arapaho | | | | | | |
| Bear Creek | 43 | 190,000 | 925 | 110 | | )1949 New |
| Clear Creek | 79 | 284,000 | 2,842 | 355 | 5/27/43 | )combined plan to be prepared. |
| Dillon | 57 | 85,900 | 1,250 | 160 | 7/13/48 | |
| Fraser River | 48 | 259,800 | 4,950 | 620 | 2/25/47 | |
| Middle Park | 262 | 1,009,000 | 16,000 | 2,000 | 6/13/47 | |
| Totals | 489 | 1,828,700 | 25,967 | 3,245 | | |
| Grand Mesa | | | | | | |
| Grand Mesa | 91 | 160,000 | 5,500 | 1,800 | 7/ 3/40 | |
| Gunnison | | | | | | |
| Baldwin | 30 | 136,000 | 2,034 | 250 | 1/12/40 | |
| Cebolla | 125 | 677,000 | 6,162 | 770 | 2/25/39 | |
| Crested Butte | 40 | 275,000 | 4,575 | 570 | 4/ 9/42 | |
| North Fork | 18 | 71,000 | 1,400 | 450 | | |
| Pitkin | 33 | 311,000 | 3,020 | 380 | 2/25/39 | |
| Sapinero | 54 | 215,000 | 4,300 | 540 | | 1949 Plan in process of preparation. |
| Taylor River | 125 | 1,221,600 | 18,000 | 2,300 | 5/11/34 | |
| Tomichi | 111 | 501,000 | 7,300 | 900 | 3/11/39 | |
| Totals | 536 | 3,407,600 | 46,791 | 6,160 | | |
| Pike | | | | | | |
| Bailey | 122 | 113,000 | 1,000 | 400 | | |
| Devils Head | 84 | 79,000 | 1,250 | 500 | | 1949 Prepare Plan |
| Lake George | 21 | 20,000 | 600 | 240 | | |
| Pikes Peak | 11 | 11,000 | 400 | 160 | | |
| South Park | 117 | 1,100 | 1,100 | 440 | 9/27/41 | |
| South Platte | 87 | 31,100 | 690 | 270 | | 1949 Some revision of plan submitted in 1948 needed |
| Totals | 442 | 255,200 | 5,040 | 2,010 | | |
| Rio Grande | | | | | | |
| Bonanza | 20 | 65,200 | 690 | 170 | 3/31/39 | |
| Carnero | 25 | 125,800 | 2,000 | 500 | 3/ 7/38 | |
| Rio Grande | 391 | 2,375,400 | 12,800 | 1,600 | 7/ 1/30 | |
| Saguache | 110 | 426,700 | 5,150 | 1,300 | 3/31/39 | |
| San Luis | 28 | 110,500 | 1,000 | 200 | | |
| Valley | 120 | 630,500 | 10,400 | 2,100 | | |
| Totals | 694 | 3,734,100 | 32,040 | 5,870 | | |

| Working Circle | Commercial Forest Acreage M Acres | Commercial Forest Timber Volume M ft. b.m. | Allowable Annual Cut M ft. b.m. | Acres Planeed to Cut Annually | Date Plan Approved | Notes |
|---|---|---|---|---|---|---|
| Colorado (Cont'd) | | | | | | |
| Roosevelt | | | | | | |
| Boulder-Este | 100 | 162,700 | 8,500 | 2,100 | 2/27/28 | |
| Laramie River | 110 | 404,700 | 14,400 | 3,600 | 11/10/25 | |
| Poudre | 203 | 746,600 | 12,500 | 3,100 | 3/15/28 | '49. Revise & prepare new plan |
| Totals | 413 | 1,314,000 | 35,400 | 8,800 | | |
| Routt | | | | | | |
| Little Snake River | 31 | 307,600 | 4,500 | 500 | 1/21/33 | 1949 Rev. now in RO |
| North Park | 130 | 896,600 | 10,000 | 1,250 | 9/18/42 | |
| Yampa River | 206 | 687,000 | 10,000 | 1,250 | 2/10/41 | |
| Totals | 367 | 1,891,200 | 24,500 | 3,000 | | |
| San Isabel | | | | | | |
| Arkansas River | 150 | 107,000 | 2,500 | 1,250 | 6/ 4/40 | |
| Huerfano | 36 | 76,000 | 1,000 | 500 | 9/ 4/34 | |
| Las Animas | 28 | 203,000 | 2,200 | 1,100 | 12/ 4/41 | |
| Poncha | 47 | 156,000 | 2,000 | 500 | 3/31/39 | |
| San Carlos | 41 | 155,000 | 2,000 | 400 | | |
| Westcliff | 51 | 109,000 | 3,250 | 810 | 4/ 7/42 | |
| Totals | 353 | 806,000 | 12,950 | 4,560 | | |
| San Juan | | | | | | 1949 Prepare Plan. |
| Animas | 95 | 507,400 | 6,000 | 2,000 | | |
| Pagosa | 150 | 1,458,900 | 10,000 | 3,300 | 2/13/42 | |
| Piedra River | 110 | 892,200 | 17,364 | 4,300 | 1/24/31 | |
| Pine River | 70 | 328,000 | 2,685 | 670 | 4/10/41 | |
| Dolores | 125 | 287,000 | 11,300 | 2,800 | 2/ 5/42 | |
| Dove Creek | 5 | 7,300 | 228 | 110 | 5/18/42 | |
| Rico | 97 | 502,800 | 6,000 | 1,200 | | |
| Totals | 652 | 3,983,600 | 53,577 | 14,380 | | |
| Uncompahgre | | | | | | |
| Alpine-Ouray | 133 | 911,700 | 8,000 | 2,600 | 2/ 7/47 | |
| Uncompahgre Val. | 195 | 168,400 | 2,000 | 660 | 5/26/47 | |
| Miguel | 63 | 151,600 | 2,100 | 700 | 4/ 7/42 | |
| Naturita | 10 | 19,200 | 400 | 130 | 6/ 5/42 | |
| Totals | 401 | 1,250,900 | 12,500 | 4,090 | | |
| White River | | | | | | |
| Bear River | 55 | 363,100 | 7,000 | 700 | 1/23/40 | |
| Colorado River | 77 | 678,000 | 13,500 | 1,350 | 1/23/40 | |
| Crystal River | 33 | 182,200 | 2,500 | 400 | 1/ 4/40 | |
| Dotsero | 78 | 582,000 | 10,000 | 1,000 | 1/23/40 | |
| Eagle River | 255 | 490,000 | 7,350 | 1,200 | 6/ 6/40 | |
| Frying Pan | 175 | 354,200 | 6,000 | 1,000 | | |
| Roaring Fork | 82 | 607,800 | 12,000 | 2,000 | 5/18/34 | |
| White River | 56 | 790,000 | 31,000 | 3,100 | 1/23/40 | |
| Willians River | 56 | 782,000 | 15,000 | 1,500 | 1/23/40 | |
| Totals | 867 | 4,829,300 | 104,350 | 12,250 | | |
| COLORADO TOTAL | 5,305 | 23,460,600 | 358,615 | 66,165 | | |

| Working Circle | Commercial Forest Acreage M Acres | Commercial Forest Timber Volume M ft. b.m. | Allowable Annual Cut M ft. b.m. | Acres Planned to Cut Annually | Date Plan Approved | Notes |
|---|---|---|---|---|---|---|
| Wyoming | | | | | | |
| Bighorn | | | | | | |
| Buffalo | 169 | 134,200 | 4,754 | 1,000 | 12/29/39 | |
| Porcupine | 76 | 94,000 | 4,683 | 1,000 | 3/11/39 | |
| Tensleep | 72 | 282,000 | 7,284 | 1,800 | 12/29/39 | |
| Tongue River | 273 | 311,200 | 8,858 | 2,000 | 1/12/40 | |
| Totals | 590 | 821,400 | 25,579 | 5,800 | | |
| Medicine Bow | | | | | | |
| Bow River | 113 | 564,000 | 10,000 | 1,400 | 6/ 3/32 | |
| Laramie Peak | 61 | 282,000 | 2,500 | 360 | | 1949 Prepare Plan |
| Platte River | 353 | 1,431,400 | 23,500 | 3,350 | 12/10/40 | |
| Pole Mountain | 10 | 15,500 | 500 | 70 | 11/24/39 | |
| Railroad | 107 | 363,000 | 10,000 | 1,400 | 12/ 3/41 | 1949 Rev.Plan |
| Snake River | 24 | 97,000 | 1,000 | 140 | | |
| Totals | 668 | 2,752,900 | 47,500 | 6,720 | | |
| Shoshone | | | | | | |
| Clarks Fork | 99 | 432,800 | 3,800 | 630 | 5/ 6/42 | |
| Glacier | 5 | 19,200 | 200 | 40 | | |
| Greybull | 31 | 101,000 | 1,240 | 200 | 3/18/43 | |
| Lander | 39 | 58,800 | 1,400 | 230 | 4/ 3/42 | |
| Shoshone River | 51 | 340,600 | 2,400 | 400 | 12/13/40 | |
| Wind River | 88 | 513,000 | 9,450 | 1,570 | 3/ 2/35 | |
| Totals | 313 | 1,465,400 | 18,490 | 3,070 | | |
| WYOMING TOTAL | 1,571 | 5,039,700 | 91,569 | 15,590 | | |
| South Dakota | | | | | | |
| Black Hills | | | | | | |
| Bearlodge | 79 | 194,500 | 3,200 | 940 | 8/ 7/39 | |
| Nemo-Rapid | 250 | 454,600 | 6,750 | 1,980 | 9/20/44 | '49.Complete rev. of plan |
| Spearfish | 238 | 567,900 | 6,500 | 1,910 | 12/15/43 | |
| Totals | 567 | 1,217,000 | 16,450 | 4,830 | | |
| Harney | | | | | | |
| Custer | 174 | 537,100 | 9,830 | 3,900 | 4/ 2/41 | )'49. Pre- |
| Elk Mountain | 16 | 65,700 | 412 | 110 | 2/ 8/40 | )liminary |
| Hill City | 127 | 204,400 | 3,700 | 1,500 | 9/18/41 | )work to |
| Limestone | 122 | 291,938 | 5,480 | 2,200 | 11/7/40 | )combine all |
| Totals | 439 | 1,099,138 | 19,422 | 7,710 | | )into 1 W.C. |
| S.DAKOTA TOTAL | 1,006 | 2,316,138 | 35,872 | 12,540 | | )w/control )within blks. |
| Nebraska | | | | | | |
| Bessey Division | | | | | | '49.Prepare plan for thinning of plantations |
| Niobrara Div. | | | | | | |
| TOTALS - R-2 | | | | | | |
| Colorado | 5,305 | 23,460,600 | 358,615 | 66,165 | | |
| Wyoming | 1,571 | 5,039,700 | 91,569 | 15,590 | | |
| S. Dakota | 1,006 | 2,316,138 | 35,872 | 12,540 | | |
| TOTAL R-2 | 7,882 | 30,816,438 | 486,056 | 94,295 | | |

TOPIC 3

# TIMBER MANAGEMENT PLAN NEEDS AND PROGRAMS

## SOUTHWESTERN REGION (3) -- FOREST SERVICE

March, 1949

Prepared for presentation at the Management Plan Conference, Hot Springs National Park, March 28, through April 8, 1949.

By C Otto Lindh
C. OTTO LINDH
Assistant Regional Forester

## A. STATUS OF MANAGEMENT PLANS* - REGION THREE

March, 1949

| National Forest | Map No. | Working Circle | Plan Dates: Last Revision | Plan Dates: Preparation or Revision Planned | Acreage (M): Commercial Forest Land** | Timber Volume Million bd.ft. | Allowable Ann.Cut: Volume Million bd.ft. | Allowable Ann.Cut: Acres | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| APACHE | 1 | Black River | 1937 | 1949 | 191 | 1,100 | 22.0 | 8,300 | Rough estimates |
| | 2 | Springerville | 1937 | 1949 | 102 | 600 | 10.0 | 3,000 | May divide into two working circles |
| | 3 | Luna | 1931 | 1950 | 26 | 100 | 2.0 | 1,200 | Rough estimates |
| | 4 | Jewett | 1931 | 1950 | 37 | 150 | 3.0 | 1,500 | " " |
| | 5 | Reserve | 1931 | 1951 | 75 | 300 | 6.0 | 3,200 | " " |
| | | Totals | - | - | 431 | 2,250 | 43.0 | 17,200 | |
| CARSON | 6 | Vallecitos Fed.S.Y.Unit | 1947(s)*** | 1952 | 66 | 137 | 1.6 | 1,000 | Fair estimates |
| | 7 | Rio Pueblo | 1941(36) | 1949 | 27 | 107 | 2.0 | 1,100 | Rough estimates |
| | 8 | Taos | 1937 | 1952 | 15 | 90 | 1.5 | 700 | " " (spruce) |
| | 9 | Canjilon | 1937 | 1950 | 16 | 63 | 1.0 | 500 | " " |
| | 10 | Jicarilla | 1935 | 1951 | 26 | 95 | 1.5 | 700 | Periodic cut |
| | 11 | Tres Piedras | 1940(s)*** | 1951 | 148 | 160 | 2.5 | 1,100 | Rough estimates |
| | | Totals | - | - | 298 | 652 | 10.1 | 5,100 | |

*For working circles with an allowable annual sawtimber cut of over 1/2 million bd. ft.

**Most acreage estimates are unreliable and mean little since the Region has no type maps. Includes mostly sawtimber stands

***(s) Indicates existing plan is acceptable for 1 to 10 years.

## A. STATUS OF MANAGEMENT PLANS* - REGION THREE

March, 1949

| National Forest | Map No. | Working Circle | Plan Dates: Last Revision | Plan Dates: Preparation or Revision Planned | Acreage (M): Commercial Forest Land** | Timber Volume Million bd.ft. | Allowable Ann. Cut: Volume Million bd.ft. | Allowable Ann. Cut: Acres | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CIBOLA | 12 | Manzano | 1939 | 1950 | 30 | 60 | 1.0 | 800 | Poor estimates |
| | 13 | Magdalena | 1929 | 1951 | 60 | 187 | 4.0 | 2,000 | Rough estimates |
| | 14 | San Mateo | 1929 | 1952 | 185 | 447 | 6.0 | 3,000 | " " |
| | 15 | Grants | 1929 | 1951 | 100 | 120 | 3.0 | 2,500 | Guess - mostly old cutovers |
| | 16 | Gallup | 1929 | 1952 | 60 | 40 | 1.0 | 1,000 | " " " |
| | | Totals | - | - | 435 | 854 | 15.0 | 9,300 | |
| COCONINO | 18 | Flagstaff | 1947(s)*** | 1951 | 770 | 3,811 | 61(9) | 39,000 | Fair estimates |
| CORONADO | | | 1948(s)*** | 1959 | 98 | 76 | 1 | 300 | (No sawtimber w.c.) |

*For working circles with an allowable annual sawtimber cut of over 1/2 million bd. ft.
**Most acreage estimates are unreliable and mean little since the Region has no type maps. Includes mostly sawtimber stands.
***(s) Indicates existing plan is acceptable for 1 to 10 years.

## A. STATUS OF MANAGEMENT PLANS* - REGION THREE

March, 1949

| National Forest | Map No. | Working Circle | Plan Dates: Last Revision | Plan Dates: Preparation or Revision Planned | Acreage (M) Commercial Forest Land** | Timber Volume Million bd.ft. | Allowable Ann. Cut: Volume Million bd.ft. | Allowable Ann. Cut: Acres | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CROOK | 19 | Mt. Graham | 1937 | 1950 | 25 | 119 | 1 | 200 | Rough estimates |
| | 20 | Clifton | 1937 | 1952 | 57 | 34 | .5 | 300 | " " |
| | | Totals | - | - | 82 | 153 | 1.5 | 500 | |
| GILA | 21 | Elk Mtn. | 1942 | 1949 | 261 | 450 | 6 | 2,000 | Policy Statement only (poor) |
| | 22 | Chloride | 1942 | 1950 | 219 | 400 | 6 | 2,000 | " " " |
| | 23 | Silver City-Santa Rita | 1942 | 1951 | 278 | 327 | 3.7 | 1,400 | " " " |
| | 24 | Glenwood | 1942 | 1952 | 58 | 129 | 1.3 | 1,000 | " " " |
| | | Totals | - | - | 816 | 1,306 | 17.0 | 6,400 | |

*For working circles with an allowable annual sawtimber cut of over 1/2 million bd. ft.
**Most acreage estimates are unreliable and mean little since the Region has no type maps. Includes mostly sawtimber stands.

## A. STATUS OF MANAGEMENT PLANS* - REGION THREE

March, 1949

| National Forest | Map No. | Working Circle | Plan Dates: Last Revision | Plan Dates: Preparation or Revision Planned | Acreage (M): Commercial Forest Land** | Timber Volume Million bd. ft. | Allowable Ann. Cut: Volume Million bd.ft. | Allowable Ann. Cut: Acres | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| KAIBAB | 25 | Williams | 1938 | 1949 | 373 | 462 | 8 | 10,700 | Rough estimates |
| | 26 | North Kaibab | 1948(s)*** | 1958 | 184 | 1,435 | 27.7 | 4,109 | Good estimates |
| | | Totals | - | - | 557 | 1,897 | 35.7 | 14,809 | |
| LINCOLN | 27 | Sacramento | 1948(s)*** | 1959 | 136 | 337 | 6.3 | 2,800 | Fair estimates |
| PRESCOTT | 28 | Walnut Creek | 1939 | 1952 | 13 | 44 | .7 | 400 | Poor estimates |
| | 29 | Prescott | 1939 | 1950 | 38 | 15 | 1.0 | 500 | Fine B.J. stands |
| | 30 | Jerome | 1939 | 1951 | 19 | 7 | .5 | 300 | " " " |
| | | Totals | - | - | 78 | 66 | 2.2 | 1,200 | |

*For working circles with an allowable annual sawtimber cut of over 1/2 million bd. ft.

**Most acreage estimates are unreliable and mean little since the Region has no type maps. Includes mostly sawtimber stands.

***(s) Indicates existing plan is acceptable for 1 to 10 years.

## A. STATUS OF MANAGEMENT PLANS* - REGION THREE

March, 1949

| National Forest | Map No. | Working Circle | Plan Dates: Last Revision | Plan Dates: Preparation or Revision Planned | Acreage (M): Commercial Forest Land** | Timber Volume Million bd. ft. | Allowable Ann. Cut: Volume Million bd. ft. | Allowable Ann. Cut: Acres | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| SANTA FE | 31 | Chama | 1948(s)*** | 1953 | 134 | 668 | 10.0 | 4,000 | Fair estimates |
| | 32 | Chupadera | 1935 | 1949 | 20 | 74 | 1.5 | 750 | Poor estimates |
| | 33 | Cuba | 1927 | 1950 | 27 | 99 | 2 | 900 | " " |
| | 34 | Jemez | 1927 | 1951 | 50 | 210 | 5 | 3,500 | " " |
| | 35 | Paliza | 1936 | 1949 | 23 | 100 | 2 | 800 | Fair estimates |
| | 36 | Bland | 1928 | 1952 | 25 | 175 | 3 | 1,300 | Poor estimates |
| | 37 | Espanola | 1927 | 1952 | 23 | 40 | .7 | 200 | Rough estimates |
| | 38 | Pecos | 1929 | 1953 | 99 | 175 | 3 | 1,500 | " " |
| | 39 | Las Vegas | 1929 | 1954 | 20 | 43 | 1 | 300 | " " |
| | | Totals | - | - | 421 | 1,584 | 28.2 | 13,250 | |

*For working circles with an allowable annual sawtimber cut of over 1/2 million bd. ft.

**Most acreage estimates are unreliable and mean little since the Region has no type maps. Includes mostly sawtimber stands.

***(s) Indicates existing plan is acceptable for 1 to 10 years.

## A. STATUS OF MANAGEMENT PLANS* - REGION THREE

March, 1949

| National Forest | Map No. | Working Circle | Plan Dates: Last Revision | Plan Dates: Preparation or Revision Planned | Acreage (M): Commercial Forest Land** | Timber Volume Million bd. ft. | Allowable Ann. Cut: Volume Million bd.ft. | Allowable Ann. Cut: Acres | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| SITGREAVES | 40 | Showlow | 1941 | 1950 | 29 | 48 | 3.0 | 3,600 | Rough estimates |
| | 41 | Heber | 1941 | 1949 | 186 | 1,350 | 25.0 | 10,000 | Poor estimates |
| | 42 | Chevalon | 1941 | 1949 | 103 | 1,130 | 19.0 | 4,400 | Fair estimates |
| | | Totals | - | - | 318 | 2,528 | 47.0 | 18,000 | |
| TONTO | 43 | Payson | 1948(s)*** | 1958 | 46 | 183 | 3.5 | 2,000 | Fair estimates |
| | 44 | Pleasant Valley | 1935 | 1949 | 92 | 256 | 3.5 | 3,000 | Rough estimates |
| | | Totals | - | - | 138 | 439 | 7.0 | 5,000 | |
| | | Region Totals | - | - | 4,578 | 15,953 | 275.0 | 130,059**** | |

*For working circles with an allowable annual sawtimber cut of over 1/2 million bd. ft.

**Most acreage estimates are unreliable and mean little since the Region has no type maps. Includes mostly sawtimber stands.

***(s) Indicates existing plan is acceptable for 1 to 10 years.

****Based on total commercial acreage and 20 yr. CC with a partial intermediate cut, the acreage cut over each year should be about 250,000 acres. Since the total acreage is apt to be off and plans or old policy statements contain no estimates on acreage to be cut annually the total given herein is only an estimate.

## SUMMARY OF MANAGEMENT PLAN STATUS

Number of Existing Acceptable Plans for Working Circles ................. 8
(35% of acreage and 43% of volume)

Number of Plans to be Revised or Prepared not now Acceptable-

| | |
|---|---|
| In 1949 (28% acreage - 34% of volume) | 10 |
| 1950 | 9 |
| 1951 | 7 |
| 1952 | 8 |
| 1953 | 1 |
| 1954 | 1 |
| Sub-total | 44 |

By end of 1949 the Region should have acceptable plans for 63% of acreage and 77% of volume.

B. Costs and Time Table for Preparing and Maintaining Plans (Includes sawtimber working circles only)

1. Status of Inventories for Management Plan Purposes

Most of the forest lands were initially inventoried in the period 1912 - 1915. Ocular estimates were made and volumes recorded section by section which have been adjusted one or more times since by random checks for each individual doing the initial work. On about 15% of the acreage, estimates are based on office guesses. Good estimates, recently made, are available for 9% of the commercial acreage.

The Region has no standard timber type maps. No work has been done on site classes or maps. The Forest Survey project has not been extended to the Southwest.

Aerial photos, on a scale of 1:20,000, are now available for 17% of the commercial forest area. They were being used for the first time, in December 1948, to delineate stand structure, and density classes, operable and inoperable areas and to a certain extent for timber types. It is anticipated they will serve as the first step in obtaining reliable data for management planning.

It is apparent that the first systematic inventory since 1915 has just been initiated. If the aerial photos prove to be as valuable as we think they will, it will be the Regional policy to do no field work on the ground for management plan purposes except in those areas where satisfactory photos are available.

2. Cost of Plan Preparation (Initial or Major Revision)

a. Field Work and Office Records

Unfortunately the Region has not had sufficient experience in modern field inventory programs to make an intelligent guess on costs. Costs will probably depend somewhat on whether the continuous or bookkeeping system is adopted, whether large scale aerial photos are available and whether mensurational research findings are available. A rough estimate would be that initially it should not cost over 10 cents an acre for aerial photos, photo interpretation and maps, essential field work and permanent records for those areas still under extensive management as our working circles are at this time. The estimate is based on the premise that 2-inch to the mile planimetric base maps will be prepared from other funds. At this rate the total cost would be $457,800 or about $90,000 per year for five years.

b. Plan Preparation (Office)

Regardless of the accuracy of the available data, it is assumed the plan will be based on the best information available and that summaries and maps are in reasonable fair shape. The cost of plan preparation is, therefore, based on office work only. Taking the kind of resource data presently available in the Region, the cost of plan preparation is as follows:

(1) Individual Plan Items (Average)

| Item | Man-Days | Cost |
|---|---|---|
| a. Source data - compiling and summaries .................. | 7 | $ 146 |
| b. Preparing type and/or classification and ownership maps .................................... | 4 | 84 |
| c. Preparing transportation plan map and record ........... | 2 | 42 |
| d. Preparing rough draft .................................. | 10 | 210 |
| e. Clerical and map reproduction .......................... | 4 | 44 |
| f. Review of rough draft by F.S. (any redrafting) ......... | 2 | 46 |
| g. Review of rough draft by R.O. (redrafting by F.S.)...... | 3 | 84 |
| h. Clerical - final draft - assembly and checking ......... | 3 | 33 |
| i. Final review in R.O. by interested Divisions ........... | 2 | 56 |
| Sub-total Regional ....................................... | 37 | 745 |
| j. Review in W.O. by all concerned ........................ | 2 | 64 |
| Total .................................................... | 39 | 809 |

(2) Cost of Meeting Regional Program for Plan Preparation (office) by 1954

| Year | No. Plans | Regional Cost @ |
|---|---|---|
| 1949 | 10 | 7,450 |
| 1950 | 9 | 6,705 |
| 1951 | 7 | 5,215 |
| 1952 | 8 | 5,960 |
| 1953 | 1 | 745 |
| 1954 | 1 | 745 |
| Total .................. | 36 | 26,820 |

3. Plan Maintenance Program and Costs

Beginning in 1951 existing acceptable plans are scheduled for revision. Presumably over 10 per cent, or 5 of the plans, will on the average have to be revised each year. If the original plan was based on accurate inventory data and adequate inventory data are currently maintained, the revision job should not be difficult or costly. Unfortunately, the Region will not reach that point, except possibly in a few cases, until after each plan is revised once. The average cost of the maintenance or revision job starting in 1951 will be about as follows:

a. Field Work and Office Records

On the basis that good aerial photos and maps are originally available, the cost of maintaining a permanent inventory - either the continuous or bookkeeping system - should not exceed one cent per acre per year even as the trend is towards intensive management (a guess, of course, as the Region has had no experience for a base). If so, the annual cost of inventorying would be about $45,000 per year for planning purposes starting in 1953 (on the basis no maintenance work will be initiated until after field work is completed in the entire Region).

b. Maintenance of Plans (office)

The first major revision will be as costly as that planned for 1949 - 1954. On the basis of revising an average of five plans per year, starting in 1951, the annual cost at $745 per plan would be $3,725 per year.

4. Summary of Plan Costs (Estimates)

| Year | Initial Field | Initial Office | Initial Total | Revision Field | Revision Office | Revision Total | Grand Total |
|---|---|---|---|---|---|---|---|
| 1948 | $ 90,000 | $ 7,450 | $ 97,450 | - | - | - | $ 97,450 |
| 1949 | 90,000 | 6,705 | 96,705 | - | - | - | 96,705 |
| 1950 | 90,000 | 5,215 | 95,215 | - | - | - | 95,215 |
| 1951 | 90,000 | 5,960 | 95,960 | - | $ 3,725 | $ 3,725 | 99,685 |
| 1952 | 90,000 | 745 | 90,745 | - | 3,725 | 3,725 | 94,470 |
| 1953 | - | 745 | 745 | $ 45,000 | 3,725 | 48,725 | 49,470 |
| 1954 | - | - | - | 45,000 | 3,725 | 48,725 | 48,725 |
| 1955 | - | - | - | 45,000 | 3,725 | 48,725 | 48,725 |
| 1956 | - | - | - | 45,000 | 3,725 | 48,725 | 48,725 |
| 1957 | - | - | - | 45,000 | 3,725 | 48,725 | 48,725 |
| 1958 | - | - | - | 45,000 | 3,725 | 48,725 | 48,725 |
| 1959 | - | - | - | 45,000 | 3,725 | 48,725 | 48,725 |
| 1960 | - | - | - | 45,000 | 3,725 | 48,725 | 48,725 |
| Totals | 450,000 | 26,820 | 476,820 | 360,000 | 37,250 | 397,250 | 874,070 |

Following 1960 the annual cost should be reduced considerably on the basis that reliable inventory data are available and currently maintained.

S
SUPERVISION
Meetings
(Timber Management Plan Conference)

March 25, 1949

TOPIC 3

TIMBER MANAGEMENT PLAN NEEDS AND PROGRAMS
REGION 4

By Paul A. Grossenbach

A glance at the tabular data attached to these sheets will help a great deal to explain the R-4 situation.

Column (9) really tells the story of our needs for management plan preparation and revision. Out of a total of 81 working circles there are only four approved plans considered satisfactory for present needs. These were approved in 1939 and 1942 and are in need of and due for some slight revision this year.

The blank spaces on the table are those for which no information was readily available.

The table is a partial copy of a rough work sheet prepared in our office last winter as an appraisal of our needs. It will be maintained as a progress record for our 10-year program of plan preparation and revision and the blanks filled in as the data become available.

As a part of the program we have tentatively classified our working circles into the following three broad groups:

Class I. - Plans or revisions urgently needed; maximum allowable cut in sight, reached, or exceeded; available inventory data either unsatisfactory or incomplete; relative importance high; project work required for inventory purposes in most cases.

Class II. - Plans or revisions needed; maximum allowable cut possible; additional or improved inventory data necessary; relative importance medium; surveys can be handled by contributed time with minor expense.

Class III. - No immediate need for better plans than are now in existence or can be prepared from data available; present cut generally far below maximum permissible; relative importance low; little or no field work required for inventory.

The purpose of this classification was primarily to point out where our needs for new or revised plans are most urgent. These, of course, are the ones to be given the most attention. It shows roughly what we need in the way of inventory data. This will be explained more fully in

(over)

Topic 12 discussions. The classification was meant to be elastic as well as the conditions within each class.

No plan preparation or revision will be held up awaiting better inventory data except when such data are assured within the period set for the preparation of that individual plan. The time schedule will be set by the forests as needed. The only Regional Office requirement is that plan preparation and revision be started as soon as possible and be completed within the 10-year period.

The date of first revision will be listed in the plan and the Regional Office work sheet containing that information will be used as a promise card to assist the forests in keeping the dates as set but the forests will be expected to revise the plans at any time the need becomes apparent.

Our inventory cost figures were borrowed from other regions as we have not as yet done enough work with aerial photo surveys to know what they will cost us. 3¢ per acre was used for Class I working circles with a total of $110,000. 1/8¢ per acre was used for Class II surveys where only minor expenses are involved--total $11,000. Class III plans and work other than surveys on Class I and II plans will be nearly all contributed time and any estimate of such costs that we might make would be so rough as to be useless.

Several items in the following table need explanation.

Column 3 is of use only for an estimation of aerial photo coverage needed. No deduction for primitive areas or other large areas withdrawn from timber use has been made. This will be done later as forest plans are completed. It will not affect Class I working circles.

Columns 4 and 5 figures were obtained from the Extensive Revision of 1945 where no management plan figures were available and in such cases no breakdown by working circles was possible.

Column 6 figures represent 1% of column 5 where no management plan estimates were available.

Column 7 figures were taken from the quarterly Cut and Sold Reports for the forests and in some cases are greater than Column 6 figures. For some forests this reflects increased war demands but wherever noted in Class III working circles we have reason to believe that column 5 figures are low.

REGION 4 — February 1949

SUMMARY OF MANAGEMENT PLAN NEEDS BY FORESTS AND WORKING CIRCLES

| (1) Forest | (2) No. and Name of Working Circle | (3) Total Gross Area M. Ac. | (4) Area Comm. Forest Land M Ac. | (5) Total Vol. M.M. ft.b.m. | (6) Allowable Annual Cut - M. | (7) Ave. Annual Cut Last 10 years M.ft.b.m. | (8) Approved Plans Date | (9) Plans Satisfactory | (10) Plans Needing Revision | (11) New Plans Needed | (12) Plans or Revisions roughed out | (13) Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ashley | 1 - 5 | | | | | | | | | 5 | | II |
| | Summary | 1,116 | 588 | 1,104 | 11,000 | 5,000 | | | | 5 | | |
| Boise | 6 Cascade | 144 | 54 | 240 | 1,538 | | 1929 | | 1 | | 1 | I |
| | 7 S. Fk. Salmon | 115 | | 171 | 1,451 | | 1930 | | 1 | | | II |
| | 8 Squaw Creek | 75 | | 72 | 687 | | | | | 1 | | I |
| | 9 N. Fk. Payette | 27 | | 24 | 240 | | | | | 1 | 1 | I |
| | 10 S. Fk. Payette | 705 | | 400 | 4,000 | | 1930 | | 1 | | 1 | I |
| | 11 Boise Basin | 340 | | 71 | 713 | | | | | 1 | | I |
| | 12 N. Fk. Boise | 247 | | 732 | 7,280 | | | | | 1 | | I |
| | 13 Mid. Fk. Boise | 276 | | 89 | 873 | | | | | 1 | | I |
| | 14 S. Fk. Boise | 391 | 69 | 480 | 4,728 | | 1938 | | 1 | | 1 | I |
| | Summary | 2,951 | 486 | 2,281 | 21,510 | 21,000 | | | 4 | 5 | 4 | |
| Bridger | 15 Green River | 1,098 | 215 | 1,356 | 16,174 | | 1931 | | 1 | | | II |
| | 16 Star Valley | 262 | 74 | 292 | 1,400 | | 1929 | | 1 | | | II |
| | 17 Greys River | | | | | | | | | 1 | | II |
| | Summary | 1,710 | 212 | 1,045* | 10,500* | 5,300 | | | 2 | 1 | | |
| Cache | 18 Bear Lake | 190 | 55 | 190 | 2,157 | | 1942 | 1 | | | | II |
| | 19 Bear River | 380 | 43 | 211 | 1,829 | | 1942 | 1 | | | | II |
| | Summary | 570 | 98 | 401 | 3,986 | 4,200 | | 2 | | | | |
| Caribou | 20 Snake River | 620 | | | | | | | | 1 | | II |
| | 18 Bear Lake | 70 | 14 | 8 | 103 | | 1942 | X | | | | II |
| | 16 Star Valley | 115 | 32 | 125 | 600 | | 1929 | | X | | | II |
| | 21 Portneuf-Poc. | 276 | | | | | | | | 1 | | II |
| | Summary | 1,081 | 128 | 154 | 1,500 | 2,000 | | | | 2 | | |
| Challis | 22 Lost River | | | | | | | | | 1 | | III |
| | 23 Stanley Basin | | | | | | | | | 1 | | III |
| | 24 Challis | | | | | | | | | 1 | | III |
| | Summary | 2,468 | 356 | 365 | 3,600 | 1,400 | | | | 3 | | |

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dixie | 25 Mammoth | 371 | | | | | | | 1 | | 1 | I |
| | 26 E. Fk. Sevier | 196 | 83 | | | | | | 1 | | 1 | I |
| | 27 Escal.-Teasdale | | | | | | | | 1 | | 1 | II |
| | 28 Pine Valley | | | | | | | | | 1 | | III |
| | Summary | 1,937 | 324 | 1,084 | 10,800 | 5,800 | | | 3 | 1 | 3 | |
| Fishlake | 29 - 32 | | | | | | | | | 4 | | III |
| | Summary | 1,526 | 46 | 93 | 900 | 1,000 | | | | 4 | | |
| Humboldt | 33 - 34 | | | | | | | | | 2 | | III |
| | Summary | 1,183 | 7 | 9 | 100 | 130 | | | | 2 | | |
| Manti | 35 - 38 | | | | | | | | | 4 | | III |
| | Summary | 796 | 105 | 223 | 2,200 | 1,500 | | | | 4 | | |
| Minidoka | 39 Twin Falls | | | | | | | | 1 | | 1 | III |
| | 40 Nevada | | | | | | | | 1 | | 1 | III |
| | 41 Burley-Oakley | | | | | | | | 1 | | 1 | III |
| | 42 Sublette | 78 | 5 | 24 | 330 | | 1942 | 1 | | | | III |
| | 43 Black Pine | 75 | 1 | 8 | 103 | | 1942 | 1 | | | | III |
| | Summary | 637 | 22 | 54 | 540 | 1,500 | | 2 | 3 | | 3 | |
| Toiyabe | 44 Mono | 678 | | | 2,000 | 400 | 1922 | | 1 | | | II |
| | 45 Toiyabe | 2,794 | 8 | 28 | 280 | | | | | 1 | | III |
| | Summary | 3,472 | | 327 | 2,280 | 400 | | | 1 | 1 | | |
| Nevada | 46 Nevada | | | | | | | | | 1 | | III |
| | 47 Charleston Mtn. | 62 | | | | | | | 1 | | 1 | II |
| | Summary | 1,260 | 10 | 41 | 400 | 240 | | | 1 | 1 | 1 | |
| Payette | 2 S. Fk. Salmon | 267 | 114 | | | | 1930 | | X | | | I |
| | 48 Payette Lakes | 109 | 38 | 380 | 10,000 | | 1931 | | 1 | | | I |
| | 1 Cascade | 32 | 6 | 36 | 400 | | 1929 | | X | | | I |
| | 49 Meadows Valley | 144 | 85 | 1,093 | 13,000 | | 1929 | | 1 | | | I |
| | 50 Salmon River | 100 | | | | | | | | 1 | | I |
| | 51 Council | 219 | 131 | 1,270 | 22,400 | | 1931 | | 1 | | | II |
| | 52 Mann Cr. | 29 | 11 | 95 | 1,200 | | 1928 | | 1 | | | II |
| | 53 Indian Valley | 41 | 23 | 177 | 2,000 | | | | 1 | | 1 | II |
| | 54 Middle Valley | 47 | 16 | 117 | 1,600 | | 1936 | | 1 | | | II |
| | Summary | 2,419 | 414 | 1,987 | 20,000 | 28,000 | | | 6 | 1 | 1 | |

| (3) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest | No. and Name of Working Cirvle | Total Gross Area M. Ac. | Area Comm. Forest Land | Total Vol. M.M. ft.b.m. | Allow-able Annual Cut - M | Ave. Annual Cut last 10 year M.ft.b.m. | Approved Plans Date | Plans Satis-tory | Plans Needing Revision | New Plans Needed | Plans or Revi-sion roughed out | Class |
| Salmon | 55 Northfork | 300 | | | 1,000 | | | | | 1 | | II |
| | 56 - 57 | | | | | | | | | 2 | | III |
| | Summary | 2,074 | 157 | 542 | 5,400 | 2,600 | | | | 3 | | |
| Sawtooth | 58 S. Fk. Boise | 414 | | | | | | | | 1 | | II |
| | 59 - 61 | | | | | | | | | 3 | | III |
| | Summary | 1,246 | 118 | 581 | 5,800 | 3,300 | | | | 4 | | |
| Targhee | 62 Spencer | 184 | 40 | | | | 1930 | | 1 | | | II |
| | 63 Island Park | 460 | | | | | | | | 1 | | II |
| | 64 - 68 | | | | | | | | | 5 | | III |
| | Summary | 1,407 | 806 | 818 | 8,200 | 8,100 | | | 1 | 6 | | |
| Teton | 69 Hoback River | 224 | 59 | | 1,355 | | 1926 | | 1 | | | III |
| | 70 - 73 | | | | | | | | | 4 | | III |
| | Summary | 1,726 | 295 | 720 | 7,200 | 1,200 | | | 1 | 4 | | |
| Wasatch | 74 Provo River | 140 | 46 | | | | 1929 | | 1 | | | I |
| | 15 Green River | 183 | 73 | | | | 1931 | | X | | | II |
| | 75 Duchesne | | | | | | | | | 1 | | III |
| | 76 | | | | | | | | | 1 | | III |
| | Summary | 1,011 | 62 | 343 | 3,430 | 4,100 | | | 1 | 2 | | |
| Uinta-La Sal | 77 N. Div. La Sal | 169 | 22 | 62 | 652 | | | | 1 | | 1 | III |
| | 74 Provo River | 101 | 23 | 83 | | | 1929 | | X | | | I |
| | 78 Duchesne | 138 | | | | | | | | 1 | | II |
| | 79 Strawberry | 391 | | | | | | | | 1 | | II |
| | 80 S. Div. La Sal | | | | | | | | | 1 | | III |
| | 81 Uinta | | | | | | | | | 1 | | III |
| | Summary | 1,527 | 121 | 340 | 3,400 | 4,500 | | | 1 | 4 | 1 | |
| TOTALS | | | | | | | | | | | | |
| | Class I | 3,665 | | | | | | | 8 | 6 | 6 | |
| | Class II | 8,987 | | | | | | 2 | 11 | 13 | 3 | |
| | Class III | 20,043 | | | | | | 2 | 5 | 34 | 4 | |
| GRAND TOTALS | | 32,695 | | | | | | 4 | 24 | 53 | 13 | |

X Shown for another forest

* Does not total correctly because summary information taken from Ext. Rev. 1945

S
SUPERVISION
Meetings
(Management Plan Conference)

March 23, 1949

TIMBER MANAGEMENT PLAN NEEDS AND PROGRAMS

Topic 3

Austin A. Hasel
Region 5

| PRESENT STATUS | NO. WORKING CIRCLES | M ACRES |
|---|---|---|
| Approved Plans | 15 | 1,089.5 |
| Data adequate for plans | 7 | 466.4 |
| Data inadequate for plans | 34 | 2,124.2 |
| No data | 41 | 2,069.3 |
| Total | 97 | 5,749.4 |

PROGRAM FOR 1949:

Inventory of two working circles in the Klamath Forest.

Revise plan for Alturas Working Circle and submit to Washington Office.

Revise plan for Eastern Lassen Working Circle.

Prepare plan for Alder Springs Working Circle, Mendocino Forest.

Initiate preparation of plans on other forests, one plan assigned to each forest where existing data are adequate.

GENERAL:

Follow behind Forest Survey and collect additional map and cruise data needed for management plan preparation.

GENERAL: (Continued)

Give first priority to areas where applications for cooperative sustained yield units have been received.

In cut-over, burned-over, and in stands making net growth, permanent plots will be established to determine future growth and mortality.

In virgin timber, permanent plots may or may not be established, depending upon need for inforamtion on logging damage and available resources for pushing the permanent plot program.

Austin A. Hasel

U. S. FOREST SERVICE
R-6

S
PLANS - R-6
Timber Management

Portland, Oregon

March 17, 1949

## TOPIC NO. ~~4~~ 3 - MANAGEMENT PLAN CONFERENCE

## TIMBER MANAGEMENT PLAN NEEDS AND PROGRAMS

On the appended pages will be found a detailed statistical summary of the Region Six timber management situation. In brief it shows that we have an aggregate of 13-1/2 million acres available for management with a total stand of 190 billion board feet, and that our estimated allowable annual cut is almost 2-1/2 billion feet. This resource and allowable annual cut is distributed among 92 working circles. For 23 of these, or about 25%, we have approved management plans, some of which date back as far as 1924. In addition, we have almost complete coverage with current local management plans. I am scheduled to speak about these tomorrow on Topic 7 of this conference and consequently will not take your time to discuss them now.

Some impression may be gained of the general size and shape of Region Six working circles by reference to the regional map displayed here upon which generalized working circle boundaries have been drawn.

The cost of management planning in Region Six is hard to appraise. Our organization of the work is such that except for specialist leadership from the Regional Office, and research, all of the work is done by forest field personnel - supervisors, their timber staff men, rangers and their timber management men. At the Regional Office level there is perhaps the equivalent of one man year of time devoted strictly to management planning each year. The contributed time of forest personnel to the activity is difficult or impossible to evaluate. In no case has special management planning personnel or extra funds been allocated to the forests for the purpose of conducting the activity.

Another element of cost which may be considered to be part and parcel of the development of management plans is the collection of resource data - management surveys. In Region Six we have the complete results of the Forest Survey, working circle by working circle, which we generally use for planning purposes. It is not all that a management planner might wish for but at this point in the history of management planning in Region Six we consider it to be entirely adequate except for a very few critical working circles. For these we have management surveys in progress or planned. Where it is necessary to conduct special inventory projects the cost of collecting the requisite information amounts to some 7 cents per acre, or about $10,000 for the average working circle.

Our job ahead in the field of management planning as we see it is to improve our local plans so as to bring them up to acceptable standards within the next ten years and to maintain existing approved plans by completely revising them and providing cutting budgets on a 10-year renewal basis.

S
PLANS
Timber Management

U. S. FOREST SERVICE
REGION SIX

Portland, Oregon

March 18, 1949

SUMMARY OF UNRESERVED COMMERCIAL FOREST ACREAGE, TIMBER VOLUME, AND ALLOWABLE ANNUAL CUT FOR NATIONAL FOREST LANDS AS OF January 1, 1948

STATE OF OREGON

| Forest | Working Circle | Subregion D=Douglas-fir P=Pine | Forest Acreage in thousand acres | Timber Volume in million ft. BM log scale | Allowable Annual Cut in million ft. BM log scale ** | Date of Approved Plan |
|---|---|---|---|---|---|---|
| Deschutes | Sisters | P | 206 | 2,340 | 31.5 (26.5) | 2/17/31 |
| | Pauline | P | 312 | 852 | 6.0 ( 6.0) | |
| | *Bend | P | 846 | 3,527 | 50.0 (41.4) | 5/25/32 |
| | | | 1,364 | 6,719 | 87.5 (73.9) | |
| Fremont | See *Bend (Deschutes) | P | | | | |
| | Lakeview | P | 346 | 3,022 | 44.0 (40.0) | 6/23/31 |
| | *Klamath | P | 389 | 2,532 | 32.5 (31.5) | 2/17/34 |
| | | | 735 | 5,554 | 76.5 (71.5) | |
| Rogue River | *Klamath | P | 169 | 1,562 | 14.0 ( 8.4) | 2/17/34 |
| | Applegate | D | 113 | 1,388 | 14.5 ( 4.5) | 6/21/48 |
| | Medford | D | 99 | 1,944 | 19.6 ( 6.2) | |
| | Rogue River | D | 198 | 6,104 | 55.5 ( 8.0) | 4/24/42 |
| | | | 579 | 10,998 | 103.6 (27.1) | |
| Siskiyou | Coquille | D | 59 | 1,631 | 24.0 | |
| | Grants Pass | D | 178 | 1,754 | 20.0 | |
| | N. Coastal | D | 34 | 804 | 9.0 | |
| | Rogue River (W) | D | 136 | 1,589 | 16.0 | |
| | S. Coastal | D | 58 | 557 | 9.0 | |
| | *Cow Creek | D | 7 | 74 | 1.0 | |
| | | | 472 | 6,409 | 79.0 | |
| Umpqua | *Cow Creek | D | 18 | 202 | 4.0 | |
| | Evans | D | 2 | 29 | 0.5 | |
| (Row River) | Cottage Grove | D | 82 | 2,521 | 42.0 | 3/20/26 |
| | Diamond Lake | D | 121 | 2,326 | 25.0 | |
| | N. Umpqua | D | 268 | 8,622 | 115.0 | |
| | S. Umpqua | D | 247 | 6,659 | 78.0 | |
| | | | 738 | 20,359 | 264.5 | |
| Mt. Hood | Clackamas-Sandy | D | 424 | 10,170 | 125.0 | |
| | Hood River | D | 80 | 2,019 | 28.0 | |
| | Silverton | D | 8 | 223 | 3.0 | |
| | East Side | P | 239 | 4,070 | 47.5 (14.6) | |
| | | | 751 | 16,482 | 203.5 (14.6) | |

| Forest | Working Circle | Subregion D=Douglas-fir P=Pine | Forest Acreage in thousand acres | Timber Volume in million ft. BM log scale | Allowable Annual Cut in million ft. BM log scale | | Date of Approved Plan |
|---|---|---|---|---|---|---|---|
| | | | | | | ** | (Alder only) |
| Siuslaw | Hebo | D | 106 | 1,928 | 54.0 | | (10/26/40) |
| | Waldport | D | 141 | 3,999 | 42.2 | | |
| | Mapleton | D | 151 | 4,048 | 87.0 | | |
| | Mary's River | D | 10 | 368 | 4.3 | | |
| | | | 408 | 10,343 | 187.5 | | |
| Umatilla | Grande Ronde | P | 95 | 562 | 7.4 | ( 2.9) | |
| | Heppner | P | 152 | 859 | 12.0 | ( 9.2) | |
| | Pendleton-Pilot Rock | P | 357 | 2,416 | 28.5 | (15.4) | |
| | *La Grande | P | 76 | 478 | 6.4 | ( 0.9) | |
| | | | 680 | 4,315 | 54.3 | (28.4) | |
| Whitman | *La Grande | P | 351 | 1,256 | 14.6 | ( 5.2) | |
| | Powder River | P | 188 | 832 | 10.1 | ( 3.8) | |
| | *Wallowa (See Wallowa) | P | | | | | |
| | *Baker | P | 486 | 2,535 | 33.5 | (22.7) | |
| | | | 1,025 | 4,623 | 58.2 | (31.7) | |
| Malheur | *Baker | P | 79 | 631 | 11.5 | ( 8.2) | |
| | John Day Valley | P | 153 | 1,120 | 14.9 | (12.3) | |
| | *Burns (Silvies) | P | 571 | 4,419 | 55.8 | (49.3) | 5/23/28 |
| | | | 803 | 6,170 | 82.2 | (69.8) | |
| Ochoco | *Burns (Silvies) | P | 224 | 1,441 | 26.6 | (26.0) | |
| | Mitchell | P | 79 | 584 | 7.3 | ( 4.1) | |
| | Grizzly | P | 134 | 1,504 | 19.3 | (16.2) | |
| | Summit | P | 251 | 2,824 | 36.5 | (31.3) | |
| | | | 688 | 6,353 | 89.7 | (77.6) | |
| Wallowa | *Wallowa | P | 253 | 1,516 | 16.9 | (10.4) | |
| | | | 253 | 1,516 | 16.9 | (10.4) | |
| Willamette | Fall Creek | D | 102 | 3,754 | 50.0 | | |
| | Little N. F. | D | 26 | 615 | 7.2 | | |
| | Lower Willamette | D | 33 | 1,028 | 15.0 | | 3/8/42 |
| | McKenzie | D | 166 | 3,705 | 58.0 | | |
| | Middle-S. Santiam | D | 190 | 4,694 | 63.0 | | |
| | N. Santiam | D | 110 | 3,130 | 32.5 | | 8/21/43 |
| | N. F. Willamette | D | 107 | 1,729 | 32.0 | | 1/19/24 |
| | Salmon Creek | D | 69 | 1,854 | 20.0 | | |
| | Salt-Hills Creek | D | 76 | 2,047 | 16.0 | | |
| | Middle Fork Willamette | D | 160 | 4,850 | 48.0 | | |
| | | | 1,039 | 27,406 | 341.7 | | |

* Working Circles in more than one forest
** In parentheses - allowable annual cut for ponderosa, sugar, and white pines.

STATE OF WASHINGTON

| Forest | Working Circle | Subregion D=Douglas-fir P=Pine | Forest Acreage in thousand acres | Timber Volume in million ft. BM log scale | Allowable Annual Cut in million ft. BM log scale ** | Date of Approved Plan |
|---|---|---|---|---|---|---|
| Chelan | Chelan | P | 56 | 273 | 2.5 ( 1.1) | |
| | Methow | P | 372 | 1,907 | 27.0 (17.0) | 2/11/40 |
| | Omak-Okanogan | P | 290 | 1,815 | 26.9 ( 7.7) | |
| | | | 718 | 3,995 | 56.4 (25.8) | |
| Columbia | Cowlitz | D | 441 | 6,120 | 70.0 | |
| | Klickitat | P | 37 | 231 | 2.0 ( 1.0) | |
| | Lewis River | D | 312 | 5,976 | 70.0 | 10/14/42 |
| | Little White Salmon | D | 55 | 986 | 12.0 | 7/5/40 |
| | Longview | D | 13 | 416 | 6.0 | |
| | Trout Lake | P | 52 | 485 | 5.5 (4.0) | |
| | Wind River | D | 140 | 1,467 | 18.0 | 6/26/40 |
| | *Silver Creek (See Snoqualmie) | D | | | | |
| | | | 1,050 | 15,681 | 183.5 (5.0) | |
| Mt. Baker | Glacier | D | 56 | 1,040 | 14.0 | |
| | Baker River | D | 97 | 2,272 | 24.0 | |
| | Marblemount | D | 79 | 1,078 | 15.0 | |
| | Suiattle | D | 50 | 863 | 12.0 | |
| | Sauk | D | 138 | 3,224 | 40.0 | 3/26/31 |
| | S. F. Stillaguamish | D | 58 | 2,114 | 22.0 | 8/2/30 |
| | Boundary | D | 17 | 373 | 4.0 | |
| | Skagit | D | 62 | 628 | 9.0 | |
| | | | 557 | 11,592 | 140.0 | |
| Olympic | Calawah | D | 50 | 2,186 | 26.0 | |
| | Dungeness | D | 27 | 42 | 0.6 | |
| | Hood Canal | D | 61 | 1,002 | 15.0 | 8/9/43 |
| | Humptulips | D | 45 | 1,827 | 25.0 | |
| | Matheny | D | 51 | 2,029 | 26.5 | |
| | Quinault | D | 21 | 671 | 8.5 | |
| | Shelton | D | 100 | 5,006 | 55.0 | 1946 |
| | Soleduck | D | 62 | 1,650 | 25.0 | |
| | | | 417 | 14,413 | 181.6 | |

| Forest | Working Circle | Subregion D=Douglas fir P=Pine | Forest Acreage in thousand acres | Timber Volume in million ft. BM log scale | Allowable Annual Cut in million ft. BM log scale ** | Date of Approved Plan |
|---|---|---|---|---|---|---|
| Snoqualmie | Big Creek | D | 24 | 374 | 9.5 | |
| | Cedar River | D | 24 | 808 | 9.0 | |
| | Green River | D | 41 | 969 | 19.5 | |
| | Pilchuck-Sultan | D | 6 | 176 | 2.0 | |
| | Puyallup | D | 12 | 474 | 5.0 | |
| | Skykomish | D | 81 | 1,769 | 22.0 | |
| | Snoqualmie | D | 20 | 335 | 6.3 | |
| | Tolt | D | 15 | 542 | 6.1 | |
| | Vail | D | 32 | 648 | 21.0 | |
| | White River | D | 80 | 2,669 | 29.0 | |
| | *Silver Creek | D | 23 | 997 | 12.0 | |
| | Naches-Tieton | P | 183 | 1,932 | 31.2 ( 9.2) | |
| | | | 541 | 11,693 | 172.6 ( 9.2) | |
| Umatilla | Clearwater | P | 90 | 417 | 5.5 (1.9) | |
| | Walla Walla | P | 48 | 271 | 3.6 (0.3) | |
| | | | 138 | 688 | 9.1 (2.2) | |
| Wenatchee | Ellensburg | P | 223 | 2,347 | 24.4 (2.0) | 6/8/29 |
| | Entiat | P | 110 | 450 | 7.2 (4.0) | |
| | Wenatchee | P | 273 | 1,696 | 26.0 (7.1) | |
| | | | 606 | 4,493 | 57.6(13.1) | |

* Working Circles in more than one forest

** In parentheses - allowable annual cut for ponderosa, sugar, and white pines.

REGIONAL TOTALS

| | Forest Acreage in Thousand Acres | Timber Volume in million ft. BM log scale | Allowable Annual Cut in million ft. BM log scale | |
|---|---|---|---|---|
| Oregon | | | | ** |
| Pine subregion | 5,956 | 40,882 | 526.8 | (386.3) |
| Douglas-fir subregion | 3,579 | 86,365 | 1,118.3 | ( 18.7) |
| | 9,535 | 127,247 | 1,645.1 | (405.0) |
| Washington | | | | |
| Pine subregion | 1,734 | 11,824 | 161.8 | ( 55.3) |
| Douglas-fir subregion | 2,293 | 50,731 | 639.0 | |
| | 4,027 | 62,555 | 800.8 | ( 55.3) |
| Totals for Region | | | | |
| Pine subregion | 7,690 | 52,706 | 688.6 | (441.6) |
| Douglas-fir subregion | 5,872 | 137,096 | 1,757.3 | ( 18.7) |
| | 13,562 | 189,802 | 2,445.9 | (460.3) |

TOTAL NUMBER OF WORKING CIRCLES

| | Pine Subregion | Douglas-fir Subregion | Total |
|---|---|---|---|
| Oregon | 18 | 31 | 49 |
| Washington | 11 | 32 | 43 |
| Total | 29 | 63 | 92 |

** In parentheses - allowable annual cut for ponderosa, sugar, and white pines.

TOPIC 3

REGION SEVEN

# TIMBER MANAGEMENT PLAN NEEDS AND PROGRAMS

Of the 4.2 million acres of land in the seven National Forests of the Region, approximately 3.8 million acres are classified as commercial forest land. About half of this area because of good site, rapid growth and ready accessibility is susceptible of intensive forest management with very frequent light cuts while the balance of the area is subject to less intensive treatment. Most of the accessible sawtimber was removed by private operators prior to acquisition of the land by the United States. However, many of the areas cutover around the turn of the century now support thrifty young stands which are rapidly developing into sawtimber size material. It should be borne in mind that the greater portion of the total acreage in the Region has been in Government ownership less than 20 years.

## Management Plans

There are 33 working circles now designated on the seven National Forests. Of these, 25 are covered by approved management plans. The Allegheny, Monongahela and White Mountain are completely covered. The Cumberland, Green Mountain, George Washington and Jefferson have gaps. Of the 25 working circles covered by approved plans, 12 working circles containing approximately 1.4 million acres are classed as satisfactory and 13 working circles containing approximately 1.6 million acres are unsatisfactory. About 3/4 million acres in eight working circles is being operated on assumed budgets, awaiting opportunity to get at the job of management plan preparation. A list of the working circles in the Region, together with a summary of the status of planning and the estimated 5 year needs and costs for plan revision and preparation are shown in the tabulations on Pages 5 and 6 . It is obvious the Region is getting behind in the job of plan revisions, and that it also has considerable need for new plans.

## Summary of Estimated 5-Year Needs and Costs

Management plans for a total of 32 working circles require attention during the 5-year period - F.Y. 1950-1954. These have been classified into three categories; namely, Minor Revisions - 11; Major Revisions - 13; and New Plans - 8. See tabulation, Page 6.

The 11 working circles included in the first category have a total of about 964 thousand acres and the management plans are classified as satisfactory, although several of these are already due for revision and the remainder will fall due within the five-year period. Considerable reasonably reliable basic information and data are already available, and it is estimated that the job of revising the plans will cost one cent per acre or a total of $9,640.

The 13 plans requiring major revisions include approximately 1,647,000 acres. While we have some information and data on these working circles, it is unreliable in varying degrees. Considerable field inventory, office compilations

and map work will have to be done as a basis for building a satisfactory plan. The cost for doing this work is estimated at 3 cents per acre or a total of $49,410.

For the 8 working circles requiring new plans, we will have to begin practically from scratch and build complete new plans. Our best estimate for this job is seven cents per acre or a total of $53,550 for approximately 765 thousand acres. This estimate takes into consideration the possibility of making use of the techniques and skilled services of the Forest Survey. However, to secure adequate data for the smaller areas involved in management of National Forest working circles, more intensive sampling is required than for the County breakdowns used in the Forest Survey Summaries. For our small working circles averaging about 100,000 acres each, the additional work by Forest Survey costs between 4 and 5 cents per acre.

The total acreage included in the 32 working circles requiring attention in varying degrees during the five-year period is approximately 3,376,000. Total cost of the job is estimated at $112,600 or an average cost of 3.3 cents per acre. On the basis of Fiscal Years, the program would be as follows:

| | 1950 | 1951 | 1952 | 1953 | 1954 | Totals |
|---|---|---|---|---|---|---|
| Estimated Cost | $ 30,040 | $ 26,180 | $ 26,850 | $ 16,390 | $ 13,140 | $ 112,600 |
| Acres | 480,000 | 374,000 | 574,000 | 673,000 | 1,275,000 | 3,376,000 |
| Av. Cost per A. | .062 | .070 | .047 | .024 | .01 | .033 |

Working circles to be covered during each of the above fiscal years are listed in the tabulation on Page 5 . The program contemplates preparing the new plans and revising those most in need of revision during the first part of the five year period. Revising the plans classed as satisfactory, even though due for early revision, would be delayed until the more urgent plans had been completed. If the job is spread over a longer period than five years, this same general priority would be followed. Following completion of the sizeable job of placing all of the working circles under up-to-date plans, it is believed that current maintenance can be handled within the limits of the Region's regular P&M finances.

In F.Y. 1948 the value of timber cut in the Region was a little over $653,000. In F.Y. 1939 it was $71,296. If trends for the first half of the present fiscal year continue it should come close to $700,000 for F.Y. 1949. Taking the various factors into consideration, including adequate facilities to handle the anticipated demand for National Forest stumpage, it seems reasonable to figure that the Region's timber sale receipts for the ten-year period during which the management plans included in the program would be effective, will average $700,000 per year or a total of $7,000,000 for ten years. On the basis of this assumption, the cost of the management plan program ($112,600) figured against the estimated stumpage value of the timber to be harvested ($7,000,000) during the effective period of the plans (10 years) would be at the rate of about 1.6% for planning purposes. This would seem to be a fairly reasonable business expenditure for planning.

## Timber Sales

During the past ten years the volume of the Region's timber sales business has nearly trebled and the total value has increased about nine times. In F.Y. 1939,

timber together with convertible products had an average stumpage value of $2.17 per M. In 1948 the average stumpage value was $7.73 per M. A summary of the Region's timber sales business by fiscal years for the period F.Y. 1939-1948 inclusive is given below:

Timber Cut, Including Convertible Products

| Fiscal Year | Volume MBM | Total Value | Av. Value Per M |
|---|---|---|---|
| 1939 | 32,861 | $ 71,296 | $ 2.17 |
| 1940 | 49,130 | 106,901 | 2.18 |
| 1941 | 67,529 | 165,096 | 2.44 |
| 1942 | 62,487 | 167,229 | 2.68 |
| 1943 | 56,044 | 206,508 | 3.68 |
| 1944 | 69,680 | 364,548 | 5.23 |
| 1945 | 82,884 | 468,324 | 5.65 |
| 1946 | 97,313 | 536,654 | 5.51 |
| 1947 | 94,304 | 620,010 | 6.57 |
| 1948 | 84,511 | 653,123 | 7.73 |

Limitation of cut is authorized separately for sawtimber and for other products. The annual cut may not exceed the limitations for any three-year period. Prior to July 1948 the Region's authorized sawtimber cut was 64,600 M. During F.Y. 1945-1947 inclusive the average yearly cut was 64,549 M or substantially the same as the authorized cut. However, as a result of changing market conditions, which makes possible the operation of lighter and less accessible stands, together with some new inventory data, the limitations of cut established by the Chief was revised upwards last July. It is now placed at 75 million for sawtimber. On the basis of the new authorization an increased cut of about 12 million sawtimber per year is desirable. In the products field the average yearly cut is way below the allowable. In order to attain the needed increase in products business, requires promotion of larger sales to existing outlets and the development of new outlets.

The following tabulations indicate the size of the job confronting the Region for both the sawtimber and products categories:

SUMMARY OF SAWTIMBER CUT
F.Y. 1945-1948 MBM

| Year | Alleg. | Cumb. | George Wash. | Green Mtn. | Jeff. | Monon. | White Mtn. | Total |
|---|---|---|---|---|---|---|---|---|
| 1945 | 5,286 | 14,806 | 6,624 | 7,889 | 1,557 | 11,579 | 12,271 | 60,012 |
| 1946 | 6,458 | 15,298 | 7,136 | 7,645 | 3,462 | 11,249 | 15,584 | 66,832 |
| 1947 | 7,244 | 13,072 | 8,628 | 7,695 | 6,771 | 11,923 | 11,471 | 66,804 |
| 1948 | 5,025 | 10,588 | 8,775 | 7,530 | 6,207 | 7,091 | 10,522 | 55,738 |
| Total | 24,013 | 53,764 | 31,163 | 30,759 | 17,997 | 41,842 | 49,848 | *249,386 |
| 4 Yr.Ave. | 6,003 | 13,441 | 7,791 | 7,690 | 4,499 | 10,461 | 12,462 | 62,347 |
| Auth. | 9,000 | 12,500 | 9,000 | 8,000 | 5,500 | 12,000 | 19,000 | 75,000 |
| Diff. | -2,997 | ≠ 941 | -1,209 | - 310 | -1,001 | -1,539 | -6,538 | -12,653 |

SUMMARY OF PRODUCTS CUT
F.Y. 1945-1948 MBM

| Year | Alleg. | Cumb. | George Wash. | Green Mtn. | Jeff. | Monon. | White Mtn. | Total |
|---|---|---|---|---|---|---|---|---|
| 1945 | 3,310 | 635 | 5,961 | 618 | 5,837 | 1,492 | 5,019 | 22,872 |
| 1946 | 9,806 | 534 | 6,942 | 135 | 7,394 | 1,018 | 4,651 | 30,480 |
| 1947 | 3,281 | 514 | 7,891 | 4,234 | 7,736 | 2,291 | 1,969 | 27,916 |
| 1948 | 2,183 | 533 | 5,553 | 3,564 | 7,284 | 2,389 | 4,034 | 25,540 |
| Total | 18,580 | 2,216 | 26,347 | 8,551 | 28,251 | 7,190 | 15,673 | *106,808 |
| 4 Yr.Ave. | 4,645 | 554 | 6,587 | 2,138 | 7,063 | 1,797 | 3,918 | 26,702 |
| Auth. | 50,000 | 6,000 | 10,000 | 10,000 | 10,000 | 10,000 | 24,000 | 120,000 |
| Diff. | -45,355 | -5,446 | -3,413 | -7,862 | -2,937 | -8,203 | -20,082 | -93,298 |

Note: Authorization established by Chief June 8, 1948
* Exclusive Experimental Forests

Contributions to local units of Government through the 25% fund has increased steadily. This is a very important matter, especially to the small town units of Government in New England. The average per acre receipts by forests for the total acquired acreage during the past four years is shown below. Practically all of the Region's receipts comes from timber sales.

RECEIPTS FROM TIMBER USE
F.Y. 1945 - 1948

| Year | Alleg. | Cumb. | George Wash. | Green Mtn. | Jeff. | Monon. | White Mtn. | Total |
|---|---|---|---|---|---|---|---|---|
| 1945 | $ 78,757 | $ 94,663 | $ 60,047 | $ 71,010 | $ 36,174 | $ 69,797 | $ 96,134 | $ 506,581 |
| 1946 | 93,157 | 106,652 | 66,368 | 58,885 | 57,519 | 75,318 | 120,086 | 577,986 |
| 1947 | 100,085 | 89,873 | 72,189 | 104,450 | 66,893 | 97,214 | 81,895 | 612,599 |
| 1948 | 80,922 | 116,652 | 100,311 | 118,598 | 64,769 | 84,344 | 106,615 | 672,211 |
| Total | $352,921 | $407,840 | $298,915 | $352,943 | $225,355 | $326,673 | $404,730 | $2,369,377 |
| 4Yr.Av | 88,230 | 101,960 | 74,729 | 88,236 | 56,339 | 81,668 | 101,183 | 592,344 |
| Av./A. Acq. | .19 | .24 | .08 | .52 | .10 | .10 | .14 | .14 |

REGION SEVEN
DETAILED SUMMARY OF MANAGEMENT PLANS BY FORESTS
(As of 3-1-49)

| Forest | Working Circle | Comm. Forest Land M Acres | Volume of Timber: Sawtimber M-MBF | Volume of Timber: Products M-MBF | Allowable Annual Cut: Sawtimber M Ft. | Allowable Annual Cut: Products M Ft. | Allowable Annual Cut: Total M Ft. | Plan Approved | Revision Date | Class of Revision | Estimated Costs 5-Year Program - By Fiscal Years: 1950 | 1951 | 1952 | 1953 | 1954 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alleg. | Allegheny | 442 | 553 | 2,138 | 6,772 | 63,902 | 70,674 | 1948 | 1958 | - | $ - | $ - | $ - | $ - | $ - | |
| Cumb. | Sublimity | 47 | 200 | - | 5,000 | 1,200 (2) | 6,200 | 1938 | 1947 | Minor | - | - | - | - | 470 | |
| | Laurel | 168 | 245 | - | 5,842 | 1,500 (2) | 7,342 | 1943 | 1949 | Minor | - | - | - | - | 1,680 | |
| | Red River | 129 | 201 (1) | - | 2,000 | 1,000 (2) | 3,000 | 1947 | 1952 | Minor | - | - | - | - | 1,290 | |
| | Rockcastle | 83 | - | - | 150 (2) | 300 (2) | 450 | - | - | New | 5,810 | - | - | - | - | |
| | Sub-Total | 427 | 646 | - | 12,992 | 4,000 | 16,992 | - | - | - | - | - | - | - | - | |
| Green Mtn. | Otter Creek | 39 | 99 | - | 1,335 | 2,500 (2) | 3,835 | 1939 | 1949 | Minor | - | - | - | - | 390 | |
| | West River | 28 | 127 (3) | - | 1,527 | 2,500 (2) | 4,027 | 1940 | 1949 | Minor | - | - | - | - | 280 | |
| | Champlain | 39 | 81 (3) | - | 1,158 | 2,000 (2) | 3,158 | 1939 | 1944 | Minor | - | - | - | - | 390 | |
| | White River | 48 | 274 | - | 3,239 | 3,000 (2) | 6,239 | 1940 | 1950 | Minor | - | - | - | - | 480 | |
| | Deerfield River | 40 | - | - | - | - | - | - | - | New | - | 2,800 | - | - | - | |
| | Sub-Total | 194 | 581 | - | 7,259 | 10,000 | 17,259 | - | - | - | - | - | - | - | - | |
| George Wash. | Calf Pasture | 177 | 64 (4) | - | 1,341 | 1,500 (2) | 2,841 | 1930 | 1935 | Major | - | - | 5,310 | - | - | |
| | Dry River | 150 | 247 (4) | - | 4,317 | 3,000 (2) | 7,317 | 1939 | 1948 | Major | - | - | 4,500 | - | - | |
| | Lost River | 88 | 34 (4) | - | 1,000 | 1,250 (2) | 2,250 | 1939 | 1948 | Major | - | - | 2,640 | - | - | |
| | Massanutten | 53 | 413 (4) | - | 630 | 750 (2) | 1,380 | 1939 | 1948 | Minor | - | - | 530 | - | - | |
| | Pedler | 106 | 110 (4) | - | 500 | 2,000 (2) | 2,500 | 1943 | 1946 | Minor | - | - | 1,060 | - | - | |
| | Warm Springs | 176 | - | - | 650 (2) | 750 | 1,400 | - | - | New | 12,320 | - | - | - | - | |
| | James River | 132 | - | - | 500 (2) | 750 | 1,250 | - | - | New | 9,240 | - | - | - | - | |
| | Sub-Total | 882 | 868 | - | 8,938 | 10,000 | 18,988 | - | - | - | - | - | - | - | - | |
| Jeff. | Glenwood | 53 | 220 (4) | - | 3,550 | 2,000 (2) | 5,550 | 1943 | 1950 | Major | - | - | - | 1,590 | - | |
| | Craig | 100 | - | - | 750 (2) | 2,500 (2) | 3,250 | - | - | New | - | 7,000 | - | - | - | |
| | Giles | 81 | - | - | 200 (2) | 500 (2) | 700 | - | - | New | - | 5,670 | - | - | - | |
| | Wythe | 78 | - | - | 750 (2) | 1,000 (2) | 1,750 | - | - | New | - | 5,460 | - | - | - | |
| | Holston | 88 | 78 (4) | - | 1,251 | 2,000 (2) | 3,251 | 1943 | 1950 | Major | - | - | - | 2,640 | - | |
| | Clinch | 75 | - | - | 600 (2) | 1,500 (2) | 2,100 | - | - | New | - | 5,250 | - | - | - | |
| | Sub-Total | 475 | 298 | - | 7,101 | 9,500 | 16,601 | - | - | - | - | - | - | - | - | |
| Monon. | Cheat | 117 | 150 | 275 | 1,300 | 7,500 | 8,800 | 1946 | 1949 | Major | - | - | - | - | 1,170 | |
| | Gauley | 190 | 119 | - | 2,701 | 2,000 (2) | 4,701 | 1943 | 1948 | Minor | - | - | - | 1,900 | - | |
| | Greenbrier | 90 | 54 (4) | - | 918 | 1,000 (2) | 1,918 | 1942 | 1949 | Major | - | - | - | 2,700 | - | |
| | Homesteads | 89 | 127 | - | 3,771 | 2,000 (2) | 5,771 | 1939 | 1944 | Major | 2,670 | - | - | - | - | |
| | Potomac | 79 | 87 (4) | - | 1,030 | 2,000 (2) | 3,030 | 1943 | 1952 | Major | - | - | - | 2,370 | - | |
| | White Sulphur | 173 | 179 (4) | - | 1,000 | 2,000 (2) | 3,000 | 1943 | 1952 | Major | - | - | - | 5,190 | - | |
| | Sub-Total | 738 | 716 | - | 10,720 | 16,500 | 27,220 | - | - | - | - | - | - | - | - | |
| White Mtn. | Saco | 226 | 505 | 825 | 9,890 | 16,500 | 26,390 | 1940 | 1947 | Major | - | - | 6,780 | - | - | |
| | Pemigewasset | 201 | 450 (3) | - | 4,000 | 4,000 (2) | 8,000 | 1943 | 1951 | Major | - | - | 8,030 | - | - | |
| | Androscoggin | 141 | 216 (3) | - | 4,230 | 4,500 (2) | 8,730 | 1943 | 1951 | Major | - | - | - | - | 4,230 | |
| | Ammonoosuc | 92 | 91 | 180 | 3,174 | 3,370 | 6,544 | 1941 | 1948 | Major | - | - | - | - | 2,760 | |
| | Sub-Total | 660 | 1,262 | 1,005 | 21,294 | 28,370 | 49,664 | - | - | - | - | - | - | - | - | |
| | Totals | 5,818 | 4,924 | 3,418 | 75,076 | 142,272 | 217,348 | - | - | - | $ 30,040 | $ 26,180 | $ 26,850 | $ 16,390 | $ 13,140 | $ 112,600 |
| | | | | | | | | | | Acres | 480,000 | 374,000 | 574,000 | 673,000 | 1,275,000 | 3,376,000 |
| | | | | | | | | | | Average Cost Per Acre | .062 | .070 | .047 | .024 | .01 | .033 |

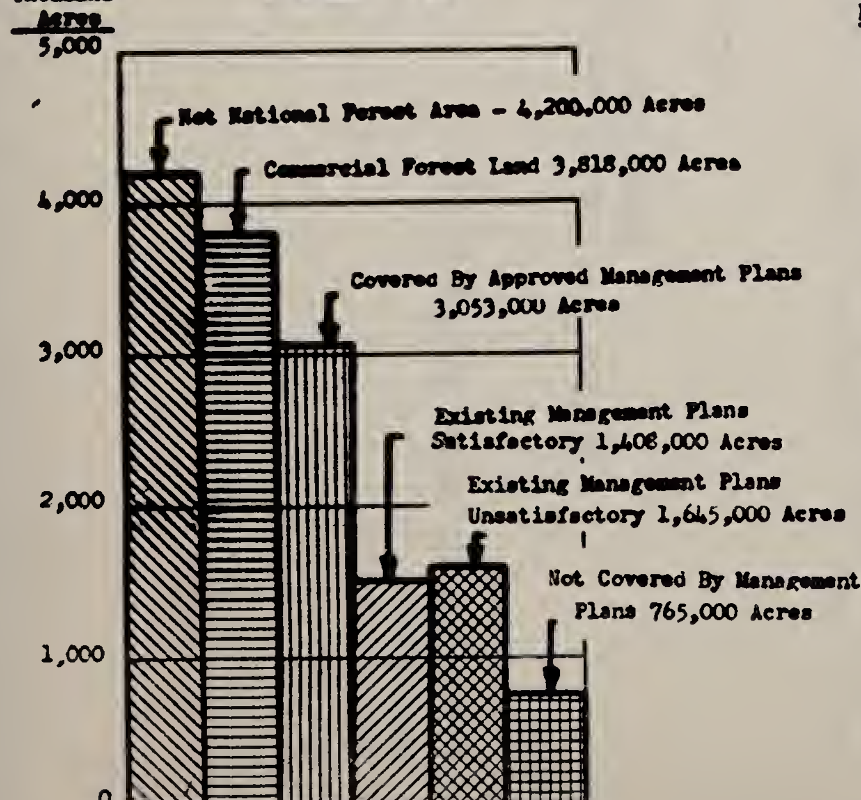
(1) Includes some cross ties
(2) Assumed budget
(3) Includes some pulpwood
(4) Includes some products

REGION SEVEN

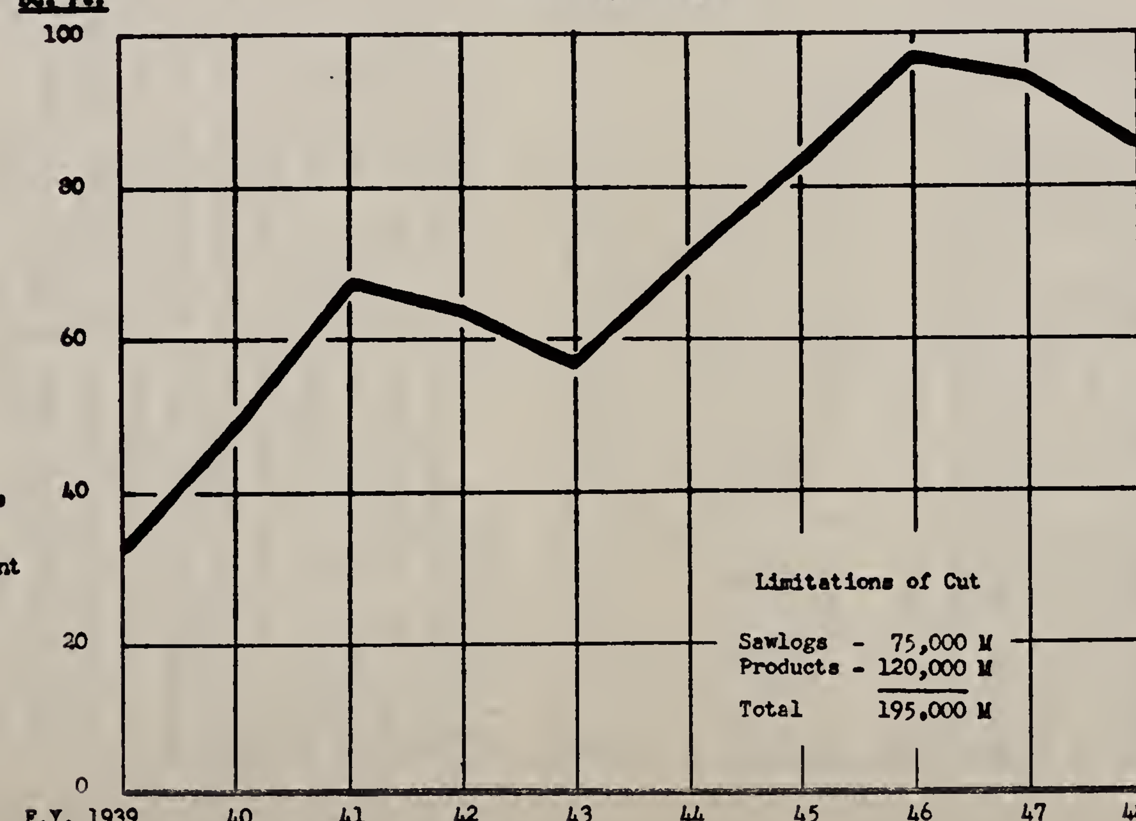
SUMMARY OF MANAGEMENT PLANS BY FORESTS (As of 3-1-49)

| Forest | No. W.C. | Area Commercial Forest Land M Acres | Covered By Approved Plans No. W.C. | Covered By Approved Plans M Acres | Approved Plans Satisfactory No. W.C. | Approved Plans Satisfactory M Acres | Approved Plans Unsatisfactory No. W.C. | Approved Plans Unsatisfactory M Acres | Not Covered By Approved Plans No. W.C. | Not Covered By Approved Plans M Acres | Estimated 5-Year Needs and Costs: Minor Revisions No. W.C. | Minor Revisions M Acres | Minor Revisions Cost Per A. | Minor Revisions Sub-Total | Major Revisions No. W.C. | Major Revisions M Acres | Major Revisions Cost Per A. | Major Revisions Sub-Total | New Plans No. W.C. | New Plans M Acres | New Plans Cost Per A. | New Plans Sub-Total | Total Job No. W.C. | Total Job M Acres | Total Job Av. Cost/A | Total Job Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Allegheny | 1 | 442 | 1 | 442 | 1 | 442 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cumberland | 4 | 427 | 3 | 344 | 3 | 344 | - | - | 1 | 83 | 3 | 344 | - | - | - | - | - | - | 1 | 83 | - | - | 4 | 427 | - | - |
| Green Mountain | 5 | 194 | 4 | 154 | 4 | 154 | - | - | 1 | 40 | 4 | 154 | - | - | - | - | - | - | 1 | 40 | - | - | 5 | 194 | - | - |
| George Washington | 7 | 882 | 5 | 574 | 2 | 159 | 3 | 415 | 2 | 308 | 2 | 159 | - | - | 3 | 415 | - | - | 2 | 308 | - | - | 7 | 882 | - | - |
| Jefferson | 6 | 475 | 2 | 141 | - | - | 2 | 141 | 4 | 334 | - | - | - | - | 2 | 141 | - | - | 4 | 334 | - | - | 6 | 475 | - | - |
| Monongahela | 6 | 738 | 6 | 738 | 2 | 309 | 4 | 429 | - | - | 2 | 307 | - | - | 4 | 431 | - | - | - | - | - | - | 6 | 738 | - | - |
| White Mountain | 4 | 660 | 4 | 660 | - | - | 4 | 660 | - | - | - | - | - | - | 4 | 660 | - | - | - | - | - | - | 4. | 660 | - | - |
| Totals | 33 | 3,818 | 25 | 3,053 | 12 | 1,408 | 13 | 1,645 | 8 | 765 | 11 | 964 | .01 | $9,640 | 13 | 1,647 | .03 | $49,410 | 8 | 765 | .07 | $53,550 | 32 | 3,376 | .033 | $112,600 |

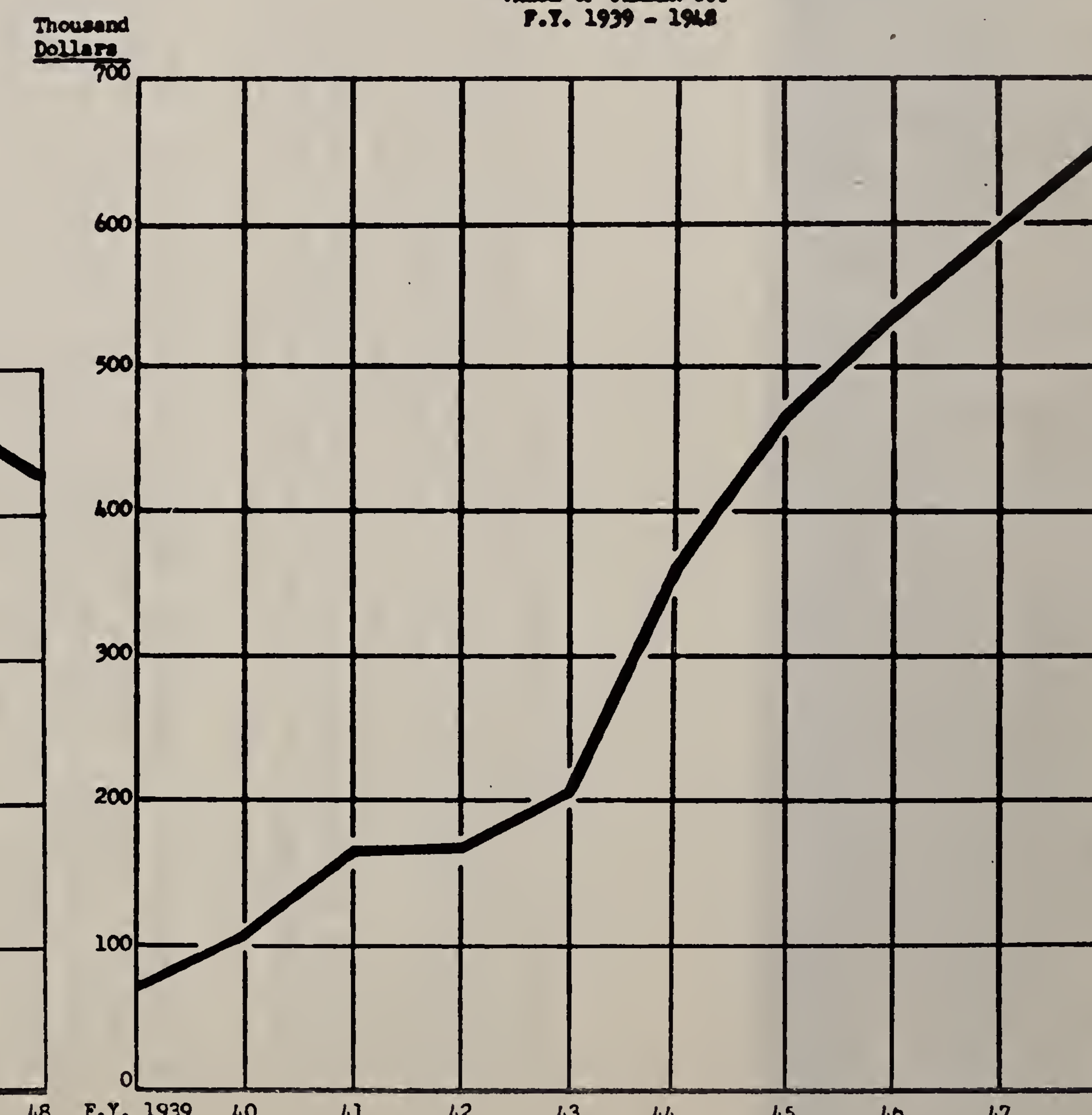
MANAGEMENT PLANS




VOLUME OF TIMBER CUT
F.Y. 1939 - 1948




VALUE OF TIMBER CUT
F.Y. 1939 - 1948



S
SUPERVISION
Meetings
(Management Plan Conference)

Topic 3 - Timber Management Plan Needs and Programs
Southern Region, Region 8

A. J. Streinz

As of June 30, 1948, the area of land in Region 8 under Forest Service administration was 9,380,000 acres. This land area with the exception of 1,000,000 acres of Public Domain land was acquired by purchase, exchange, donation, and transfer from other agencies. Most of the timber stands thereon were cutover or culled prior to acquisition. The present day timber stands are mixtures of second-growth and old growth timber. The net merchantable sawtimber volume is at least 13 billion board feet, Scribner. Shortleaf pine and loblolly pine are the predominating softwoods. The red and white oaks are the predominating hardwoods. The average annual cut for the last three year period was 400,000,000 board feet of sawtimber and convertible products. Its contract value was $2,990,000.

The 9,380,000 acres of national forest land has been subdivided to form 64 units of timber management or working circles (See Table 1). The working circles range in size from 20,000 acres to 557,000 acres of national forest land. The average is 147,000 acres. The average annual cut for the last three year period by working circles ranges from 0 to 25,910 MBF with an average of 6,372 MBF. Each of the 12 Forest Supervisors has from 2 to 8 working circles. The average is 5.

There are 14 working circles with timber management plans approved by the Chief which are satisfactory for a period of at least 5 years (See Table 2) During this period 11 of these plans will require cutting budget revisions. Seven of the 11 cutting budget revisions are now in preparation and should be completed by June 30, 1949. There are 50 working circles without satisfactory timber management plans. It is the Region's objective to have timber management plans prepared and written for these working circles by June 30, 1953. Timber management plans for 27 working circles are in preparation of which 21 should be completed by June 30, 1949.

The estimated cost of the Region's 5-year program is $172,971. This includes $6475 for cutting budget revisions of approved plans and $166,496 for the preparation and revision of timber management plans. The latter includes the preparation of two types of plans: (1) based on available data and a study of Forest Service cutover sale areas to check on the cutting cycle; (2) based on an up-to-date type and stand class map and up-to-date estimates of volume and increment for each type and stand class and for the working circle.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TABLE I - TIMBER MANAGEMENT PLAN PROGRAM, REGION 8
5-YEAR PERIOD, JULY 1, 1948 to JUNE 30, 1953

| Map No. | Forest | Working Circle | N. F. Land M Acres | Commercial N. F. Land M Acres | Timber Volume MBF (1) | Allowable Annual Cut MBF (2) | Annual Cutting Area Acres | Plan Approved By Chief For Period: | Three-Year Average Cut (3) MBF | Three-Year Average Cut (3) Value | Job (4) | Fiscal Year Work To Be Done and Cost '49 | '50 | '51 | '52 | '53 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Alabama | Black Warrior | 178 | 177 | 528,148 | 19,000 | 14,300 | 7/1/46-6/30/56 | 11,230 | $ 63,819 | 1 | | | | | |
| 2 | | Cahaba | 67 | 66 | 150,075 | 6,700 | 5,024 | 7/1/46-6/30/56 | 3,781 | 33,197 | 1 | | | | | |
| 3 | | Conecuh | 84 | 83 | 24,504 | 700 | 330 | | 139 | 924 | * | $ 1,000 | | | | |
| 4 | | Pondville | 89 | 89 | 175,348 | 7,350 | 5,326 | 7/1/46-6/30/56 | 2,860 | 23,574 | 1 | | | | | |
| 5 | | Shoal Creek | 98 | 96 | 245,628 | 7,220 | 9,579 | | 5,256 | 66,057 | * | $ 292 | | | | |
| 6 | | Talladega | 104 | 102 | 203,666 | 6,334 | 4,995 | | 231 | 2,234 | * | $ 293 | | | | |
| | | Sub-Total | 620 | 613 | 1,327,369 | 47,304 | 39,554 | | 23,497 | $ 189,805 | | $ 1,585 | | | | |
| 7 | Chattahoochee | Armuchee | 50 | 50 | 30,000 | 500 | 500 | | | | 4 | | | | $ 6,000 | |
| 8 | | Clayton | 169 | 167 | 349,123 | 5,500 | 2,500 | 1/1/38-12/31/67 | 5,360 | 43,324 | 2* | $ 100 | | | | |
| 9 | | Cohutta | 93 | 90 | 95,070 | 1,200 | 900 | 1/1/37-12/31/66 | 5,840 | 22,721 | 2* | $ 100 | | | | |
| 10 | | Cornelia | 47 | 47 | 100,000 | 1,000 | 4,700 | | 271 | 3,363 | 4 | $ 700(map) | $4,655 | | | |
| 11 | | Northern | 177 | 172 | 350,100 | 4,200 | 4,940 | 1/1/36-12/31/65 | 25,111 | 98,289 | 2 | | | $ 1,000 | | |
| 12 | | Southern | 122 | 120 | 219,610 | 5,500 | 1,236 | 7/1/38-12/31/57 | 3,325 | 28,209 | 2* | $ 100 | | | | |
| | | Sub-Total | 658 | 646 | 1,143,903 | 17,900 | 14,776 | | 39,907 | $ 195,906 | | $ 1,000 | $4,655 | $ 1,000 | $ 6,000 | |
| 13 | Cherokee | Erwin | 78 | 70 | 117,000 | 2,800 | 2,352 | 1/1/37-12/31/61 | 3,359 | $ 17,080 | 2* | $ 400 | | | | |
| 14 | | French Broad | 71 | 69 | 37,385 | 1,000 | 650 | | 3,481 | 16,901 | 3 | $ 1,000 | | | | |
| 15 | | Hiwassee | 87 | 85 | 145,000 | 3,400 | 5,600 | 1/1/36-12/31/55 | 2,591 | 12,548 | 2 | | $ 1,000 | | | |
| 16 | | Ocoee | 69 | 68 | 114,085 | 1,500 | 920 | 1/1/36-12/31/65 | 4,351 | 23,214 | 2 | | $ 1,000 | | | |
| 17 | | Tellico-Citico | 125 | 123 | 57,139 | 500 | 540 | | 1,406 | 5,838 | * | $ 400 | | | | |
| 18 | | Watauga | 143 | 140 | 166,800 | 2,600 | 1,500 | | 7,073 | 38,071 | 3 | | | $ 1,000 | | |
| | | Sub-Total | 573 | 555 | 637,409 | 11,800 | 11,562 | | 22,261 | $ 113,652 | | $ 1,800 | $ 2,000 | $ 1,000 | | |
| 19 | Florida | Apalachicola | 289 | 269 | 131,943 | 6,250 | 27,700 | 1/1/38-12/31/47 | 14,110 | $ 73,465) | 4 | $10,000 | | | | |
| 19a | | Wakulla | 268 | 244 | 29,140 | 7,285 | 25,100 | | 4,419 | 25,074) | | | | | | |
| 20 | | Osceola Intensive | 20 | 17 | 14,088 | 1,750 | 760 | 7/1/40-6/30/50 | 1,246 | 7,084) | 4 | | | $ 7,500 | | |
| 21 | | Osceola | 137 | 135 | 109,456 | 6,933 | 5,559 | 7/1/40-6/30/50 | 8,132 | 53,984) | | | | | | |
| 22 | | Ocala-Paisley | 151 | 146 | 31,300 | 3,400 | 1,138 | | 2,433 | 18,252) | 4 | | $10,000 | | | |
| 22a | | Ocala-Sand Pine | 203 | 198 | 205,301 | 10,820 | 2,503 | 1/1/37-12/31/71 | 7,539 | 15,041) | | | | | | |
| | | Sub-Total | 1,068 | 1,009 | 521,228 | 36,438 | 62,760 | | 37,879 | $ 192,900 | | $10,000 | $10,000 | $ 7,500 | | |
| 23 | Kisatchie | Catahoula | 98 | 98 | 95,000 | 5,100 | 5,000 | | 6,663 | $ 45,038 | * | $ 2,000 | | | | |
| 24 | | Evangeline | 120 | 98 | 25,362 | 800 | 800 | | 604 | 3,409 | 4 | | $ 6,255 | | | |
| 25 | | Kisatchie | 92 | 92 | 55,900 | 2,933 | 2,900 | | 2,411 | 14,816 | * | $ 300 | | | | |
| 26 | | Vernon | 81 | 81 | 792 | 100 | 100 | | 494 | 2,637 | 4 | | | $ 6,135 | | |
| 27 | | Winn | 169 | 167 | 652,043 | 18,500 | 10,046 | | 14,497 | 123,484 | 3* | | $ 1,000 | | | |
| | | Sub-Total | 560 | 536 | 829,097 | 27,433 | 18,846 | | 24,669 | $ 189,384 | | $ 2,300 | $ 7,255 | $ 6,135 | | |
| 28 | Mississippi | Bienville | 175 | 174 | 304,145 | 6,700 | 2,851 | | 16,230 | 108,582 | * | $ 3,500 | | | | |
| 29 | | Biloxi | 120 | 113 | 152,895 | 1,735 | 2,210 | | 4,863 | 23,886 | * | $ 3,500 | | | | |
| 30 | | Chickasawhay | 144 | 138 | 3,534 | 51 | 600 | | 9,333 | 22,176 | 4 | | | $ 7,215 | | |
| 31 | | Delta | 59 | 59 | 121,713 | 6,000 | 2,000 | | 2,769 | 38,279 | 4 | | $ 6,430 | | | |
| 32 | | Holly Springs | 123 | 122 | 83,445 | 1,000 | 4,062 | | 1,857 | 19,051 | 4 | | | | $ 7,095 | |
| 33 | | Homochitto | 189 | 186 | 557,000 | 26,000 | 18,900 | 1/1/37-12/31/47 | 12,976 | 85,608 | * | $ 7,500 | | | | |
| 34 | | Leaf River | 234 | 197 | 17,706 | 500 | 848 | | 12,958 | 46,499 | 4 | | $ 8,430 | | | |
| | | Sub-Total | 1,044 | 989 | 1,240,438 | 41,986 | 31,471 | | 60,986 | $ 344,081 | | $14,500 | $14,860 | $ 7,215 | $ 7,095 | |
| 35 | Nantahala | Franklin | 187 | 167 | 210,521 | 3,300 | 1,530 | | 25,910 | $ 49,211 | 3 ) | $ 1,000 | | | | |
| 36 | | Nantahala | 247 | 200 | 350,000 | 2,700 | 2,780 | 1/1/36-12/31/65 | 16,941 | 53,546 | 2*) | | | | | |
| | | Sub-Total | 434 | 367 | 560,521 | 6,000 | 4,310 | | 42,851 | $ 102,757 | | $ 1,000 | | | | |

Continued on next page.

| Map No. | Forest | Working Circle | N. F. Land M Acres | Commercial N. F. Land M Acres | Timber Volume MBF (1) | Allowable Annual Cut MBF (2) | Annual Cutting Area Acres | Plan Approved By Chief For Period: | Three-Year Average Cut (3) MBF | Three-Year Average Cut (3) Value | Job(4) | Fiscal Year Work To Be Done and Cost '49 | '50 | '51 | '52 | '53 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37 | Ouachita | Eagleton | 154 | 140 | 152,824 | 3,100 | 3,132 | 1/1/37-12/31/56 | 3,542 | 41,249 | 3 | | | $1,000 | | |
| 38 | | Fourche | 202 | 194 | 250,000 | 4,000 | 4,300 | | 4,869 | 61,290 | 3 | | $1,000 | | | |
| 39 | | Hot Springs | 99 | 94 | 218,630 | 4,100 | 3,580 | | 4,982 | 109,416 | 3 | | $1,000 | | | |
| 40 | | K. C. S. | 111 | 100 | 152,054 | 3,200 | 6,150 | 1/1/37-12/31/56 | 4,266 | 65,206 | 3 | $ 1,000 | | | | |
| 41 | | Kiamichi | 179 | 163 | 24,373 | 500 | 500 | | 599 | 4,430 | 3 | | | $1,000 | | |
| 42 | | Oden | 384 | 380 | 384,209 | 6,800 | 15,500 | 1/1/37-12/31/61 | 4,139 | 66,093 | 3* | * | | | | |
| 43 | | Rock Island | 142 | 133 | 187,722 | 4,000 | 7,256 | 1/1/37-12/31/56 | 7,964 | 91,196 | 3 | $ 1,000 | | | | |
| 44 | | Womble | 223 | 217 | 152,999 | 2,800 | 4,350 | 1/1/37-12/31/66 | 9,823 | 104,061 | 3* | $ 1,000 | | | | |
| | | Sub-Total | 1,494 | 1,421 | 1,522,811 | 28,500 | 44,768 | | 40,184 | 542,941 | | $ 3,000 | $ 2,000 | $ 2,000 | | |
| 45 | Ozark | Boston Mtn. | 493 | 466 | 395,670 | 11,168 | 23,404 | 7/1/41-6/30/51 | 12,542 | 217,649 | 4 | | $12,270 | | | |
| 46 | | Magazine Mtn. | 81 | 79 | 132,972 | 1,000 | 5,312 | | 1,119 | 7,879 | 3 | | | | $ 1,000 | |
| 47 | | Sylamore | 132 | 120 | 199,531 | 1,676 | 8,028 | 1/1/38-12/31/57 | 2,730 | 25,043 | 2* | $ 1,075 | | | | |
| 48 | | White Rock | 316 | 291 | 286,142 | 9,153 | 30,651 | 7/1/41-6/30/56 | 4,934 | 47,234 | 4 | | | $10,000 | | |
| | | Sub-Total | 1,022 | 956 | 1,014,315 | 22,997 | 67,395 | | 21,325 | $ 297,805 | | $ 1,075 | $12,270 | $10,000 | $ 1,000 | |
| 49 | Pisgah-Croatan | Big Ivy | 18 | 15 | 31,947 | 763 | 331 | | 1,343 | 16,439 | 3 | 375 | | | | |
| 50 | | Boone | 128 | 124 | 197,000 | 3,400 | 2,100 | Jan.1940-Dec.'59 | 3,652 | 26,828 | 2 | 700 | | | | |
| 51 | | Croatan | 152 | 103 | 80,000 | 1,860 | 695 | | 1,054 | 9,435 | 4 | 1,970(map) | 5,250 | | | |
| 52 | | French Broad | 102 | 99 | 147,092 | 2,400 | 945 | | 2,081 | 3,841 | 3 | 100 | | | $ 1,000 | |
| 53 | | Mt. Mitchell | 82 | 80 | 193,500 | 2,600 | 1,016 | | 4,740 | 33,953 | 3 | 100 | | $ 1,000 | | |
| 54 | | Pisgah-Sherwood | 123 | 118 | 150,000 | 2,000 | 3,000 | | 5,322 | 21,370 | 3* | 375 | | | | |
| 55 | | Roan Mtn. | 21 | 16 | 20,000 | 400 | 300 | | 2,707 | 11,199 | 3 | 100 | | $ 1,000 | | |
| 56 | | Uwharrie | 38 | 38 | 78,000 | 3,000 | 3,700 | | 889 | 10,333 | * | 120 | | | | |
| | | Sub-Total | 664 | 593 | 897,539 | 16,423 | 12,087 | | 21,788 | $ 133,398 | | $ 3,840 | $ 5,250 | $ 2,000 | $ 1,000 | |
| 57 | South Carolina | Enoree | 164 | 158 | 78,298 | 750 | 358 | | 6,504 | 47,031 | 4 | 2,337(map) | 5,333 | | | |
| 58 | | Francis Marion | 245 | 234 | 889,650 | 31,670 | 14,430 | Jan.'36-Dec.'55 | 16,344 | 148,230 | * | (*) | | | | |
| 59 | | Long Cane | 105 | 98 | 38,028 | 600 | 333 | | 3,979 | 41,229 | 4 | 2,338(map) | | $ 4,628 | | |
| 60 | | Mountain | 71 | 59 | 108,000 | 2,000 | 1,641 | Jan.'38-Dec.'57 | 2,396 | 15,771 | 2 | | | | | $ 1,000 |
| | | Sub-Total | 585 | 549 | 1,113,976 | 35,020 | 16,762 | | 29,223 | 252,261 | | $ 4,675 | $ 5,333 | $ 4,628 | | $ 1,000 |
| 61 | Texas | Angelina | 154 | 152 | 52,163 | 1,333 | 1,000 | | 4,166 | 35,837 | 4* | | $ 1,000 | | | |
| 62 | | Crockett | 161 | 160 | 697,000 | 44,200 | 24,000 | Jan.'37-Dec.'46 | 23,552 | 254,880 | 4* | | $ 1,000 | | | |
| 63 | | Sabine | 184 | 180 | 757,227 | 22,466 | 13,000 | | 6,715 | 47,851 | 4* | $ 3,000 | | | | |
| 64 | | Sam Houston | 159 | 156 | 577,777 | 4,375 | 8,489 | Jan.'38-Dec.'47 | 8,785 | 93,848 | 4* | $ 2,000 | | | | |
| | | Sub-Total | 658 | 648 | 2,084,167 | 72,374 | 46,489 | | 43,218 | $ 432,416 | | $ 5,000 | $ 2,000 | | | |
| | | GRAND TOTAL | 9,380 | 8,882 | 12,892,773 | 364,175 | 370,780 | | 407,788 | $2,987,306 | | $49,775 | $65,623 | $41,478 | $15,095 | $ 1,000 |

(1) As of date of timber survey.
(2) Regulated sawtimber species
(3) Fiscal years '46, '47, '48. Includes sawtimber and convertible products.
(4) Job symbols:
   * Carry-over plan to be completed as shown.
   1. No revision anticipated for duration of plan.
   2. Cutting budget revision due as shown.
   3. Write plan based on available data and study of F. S. cutover sale areas to check cutting cycle.
   4. Write plan based on stand map, up-to-date estimate of volume and increment.

Table 2

Timber Management Program Region 8
5-Year Period July 1, 1948 to June 30, 1953

| Class | Working Circle | | N. F. Land | | Timber Volume | | Allowable Cut | | Three Year Average Cut | | Cost Fiscal Years | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | % | M Acres | % | MBF | % | MBF | % | MBF | % | '49 - '53 | % |
| 1 | 3 | 5 | 334 | 4 | 853,571 | 6 | 33,050 | 9 | 17,871 | 5 | $ - | - |
| 2 | 7 | 11 | 969 | 10 | 1,527,334 | 12 | 22,776 | 6 | 41,207 | 10 | 2,475 | 2 |
| 3 | 4 | 6 | 404 | 4 | 717,185 | 6 | 11,100 | 3 | 34,449 | 8 | 4,000 | 2 |
| 1-3 | 14 | 22 | 1,707 | 18 | 3,098,090 | 24 | 66,926 | 18 | 93,527 | 23 | $ 6,475 | 4 |
| 4 | 27 | 42 | 4,263 | 46 | 6,411,940 | 50 | 204,874 | 56 | 202,940 | 50 | $63,511 | 36 |
| 5 | 10 | 16 | 1,232 | 13 | 1,958,234 | 15 | 39,200 | 11 | 46,209 | 11 | 10,300 | 6 |
| 6 | 13 | 20 | 2,178 | 23 | 1,424,509 | 11 | 53,175 | 15 | 65,112 | 16 | 92,685 | 54 |
| 4-6 | 50 | 78 | 7,673 | 82 | 9,794,683 | 76 | 297,249 | 82 | 314,261 | 77 | 166,496 | 96 |
| 1-6 | 64 | 100 | 9,380 | 100 | 12,892,773 | 100 | 364,175 | 100 | 407,788 | 100 | $172,971 | 100 |

Class 1- Working Circles with timber management plans approved by Chief which are satisfactory for duration of plan.

Class 2- Working Circles with timber management plans approved by Chief with cutting budget revisions in preparation.

Class 3- Working Circles with timber management plans approved by Chief with cutting budget revisions to be made during 5-year period FY '49 to '53 inclusive.

Class 4- Working Circles for which timber management plans are being prepared. 6 plans to be completed FY '50, 21 plans to be completed FY '49.

Class 5- Working Circles for which timber management plans are to be prepared based on available data and study of cutover F. S. sale areas to check cutting cycle.

Class 6- Working Circles for which timber management plans are to be prepared based on stand map, up-to-date estimate of volume and increment.

Milwaukee 3, Wisconsin
March 17, 1949

MANAGEMENT PLAN CONFERENCE

Topic 3 - Timber Management Plan Needs and Programs.

At the present time all Forests in Region 9, with the exception of the Hoosier and Wayne purchase units, are covered with management plans or policy statements. In all instances the existing plans are based on very extensive data resulting from acquisition surveys and old timber surveys. None of the plans are tied to the ground. They are in effect policy statements and in this capacity have served a useful purpose as guides in the management of the forest resource. Most of these plans have either passed the indicated revision date or will be up for revision soon. (See Table 1 Status of Management Plans and Policy Statements.)

During the past twenty year period the emphasis in management has been to build up the growing stock by stand improvement measures and to reforest the many thousands of acres of understocked and denuded land. Such a program of management, in conjunction with excellent fire protection, has resulted in a growing forest capable of producing a substantial volume of timber products. These products are and have been for the past few years in great demand by wood using industries and the time has come to arrange for the orderly harvest of the products from the forest. The present policy statements are not believed adequate to guide us in the intensive management of the forest resource. Accordingly, Region 9 has initiated a program to cover all Forests, except the Hoosier and Wayne purchase units, with an intensive management plan survey within the next ten years. Management plans will be prepared for each of the working circles after the survey is completed and the data analyzed. Table 2 sets forth a summary of the Regional situation, time schedule for bringing the plans up to date, and the estimated cost. It is our plan to re-inventory the forest resource every 10 - 15 years and make any necessary revisions of the plans at that time. In the meantime a record of accomplishments will be maintained as well as a correction map for each working circle to aid in maintenance of the plans.

[illegible] Management
General

Milwaukee 3, Wisconsin
March 9, 1949

Table 1.

REGION 9 - STATUS OF MANAGEMENT PLANS AND POLICY STATEMENTS.

| Forest | Working Circle | 1/ Gross Area: Acres | 2/ Total Gov't. Area: Acres | 2/ Commercial Forest Land Gov't.-Acres | 2/ Timber Volume MBM | 3/ Annual Allowable Cut - MBM | 3/ Plan Approved Date | 3/ Indicated Revision Date |
|---|---|---|---|---|---|---|---|---|
| Chippewa 590,951 Acres | Bena | 182,036 | 68,283 | 57,255 | 88,563 | 4,970 | 6/18/37 | 1/1/47 |
| | Blackduck | 146,805 | 58,283 | 54,536 | 44,567 | 2,147 | 7/15/43 | 1/1/50 |
| | Cass Lake | 131,445 | 75,067 | 63,844 | | 3,818 | | |
| | Cut Foot Sioux | 178,195 | 79,425 | 71,949 | 126,400 | 2,912 | 4/23/37 | 1/1/47 |
| | Dora Lake | 179,013 | 78,000 | 75,930 | | 1,349 | | |
| | Marcell | 181,559 | 97,278 | 92,691 | 60,276 | 2,034 | 11/15/45 | 7/1/55 |
| | Remer | 180,144 | 91,335 | 87,345 | 24,496 | 912 | | |
| | Walker | 134,242 | 44,014 | 36,330 | 25,263 | 661 | 3/11/47 | 7/1/55 |
| | Entire Forest | 1,313,459 | 591,685 | 539,882 | 527,260 | 18,803 | | |
| Superior 2,035,766 Acres | Cook | 822,986 | 584,314 | 528,805 | 1,572,166 | 46,236 | 12/31/36 | 1/1/46 |
| | Big Lake | 366,970 | 233,661 | 213,262 | 486,243 | 25,034 | 3/29/39 | 1/1/47 |
| | Kabetogama | | | 104,719 | | | | |
| | Kawishiwi | 513,239 | 285,318 | 253,620 | 643,639 | 26,228 | 3/29/39 | 1/1/47 |
| | Mesaba | 248,489 | 121,200 | 107,954 | 22,170 | 1,571 | 4/24/44 | 6/30/47 |
| | Stony | 871,641 | [illegible] | 407,127 | 916,321 | 34,361 | 3/29/39 | 1/1/47 |
| | Entire Forest | 3,727,549 | 1,980,502 | 1,615,487 | 4,536,672 | 133,430 | | |
| Chequamegon 816,540 Acres | Flambeau | 179,000 | 141,000 | 104,000 | 32,703 | 4,049 | | |
| | Chippewa | 301,000 | 261,000 | 227,000 | 130,567 | 8,863 | | |
| | Mondeaux | 172,000 | 113,000 | 103,000 | 48,471 | 3,461 | | |
| | Moquah | 142,000 | 119,000 | 118,000 | 2,309 | 507 | | |
| | Namekagon | 237,000 | 169,000 | 153,000 | 61,004 | 6,291 | | |
| | Entire Forest | 1,031,000 | 803,000 | 705,000 | 275,154 | 23,171 | 9/15/42 | 1/1/52 |
| Nicolet 629,595 Acres | Argonne | 161,493 | 121,680 | 92,583 | 187,542 | 5,453 | | |
| | Eagle River | 165,587 | 102,080 | 94,136 | 172,174 | 5,725 | | |
| | Florence | 168,114 | 89,915 | 74,969 | 56,802 | 3,330 | | |
| | Lakewood | 238,466 | 156,266 | 143,654 | 135,631 | 18,937 | | |
| | Laona | 251,716 | 145,495 | 132,148 | 82,440 | 5,848 | | |
| | Entire Forest | 985,376 | 615,436 | 537,490 | 634,589 | 39,293 | 8/18/47 | 7/1/53 |

REGION 9 - STATUS OF MANAGEMENT PLANS AND POLICY STATEMENTS.

| Forest | Working Circle | 1/ Gross Area Acres | 2/ Total Gov't. Area Acres | 3/ Commercial Forest Land Gov't.-Acres | 2/ Timber Volume MBM | 2/ Annual Allowable Cut - MBM | 2/ Plan Approved Date | 3/ Indicated Revision Date |
|---|---|---|---|---|---|---|---|---|
| Lower Michigan | Baldwin | 455,676 | 132,290 | | 159,580 | 5,257 | | |
| 785,525 Acres | Cadillac | 210,497 | 99,926 | | 52,875 | 1,874 | | |
| | Manistee | 233,674 | 73,475 | | 60,357 | 3,272 | | |
| | White Cloud | 345,208 | 38,527 | | 76,421 | 1,050 | | |
| | Manistee Div. (Total) | | | 329.000 | | | 9/4/41 | 11/1/46 |
| | Mio | 324,300 | 189,100 | 180,300 | 101,179 | 3,616 | 5/1/49 | 1/1/45 |
| | Tawas | 444,900 | 187,200 | 171.100 | 76,925 | 3,166 | 12/17/38 | 1/1/45 |
| | Entire Forest | 2,024,055 | 720,523 | 680,400 | 547,137 | 18,205 | | |
| Ottawa | Gogebic | 1,039,000 | 287,000 | 283,987 | 103,861 | 9,222 | | |
| 791,594 Acres | Ontonagon | 405,000 | 252,000 | 243,000 | 130,335 | 11,623 | 3/7/47 | 7/1/54 |
| | Paint River | 299,000 | 162,000 | 152,000 | 85,799 | 8,107 | 2/24/47 | 7/1/54 |
| | Entire Forest | 1,743,000 | 701,000 | 678,987 | 319,995 | 28,952 | | |
| Upper Michigan | Munising | 301,027 | 157,632 | 109,627 | 45,493 | 1,335 | | |
| 793,963 Acres | Rapid River | 296,278 | 150,242 | 114,917 | 127,413 | 2,315 | | |
| | Manistique | 224,707 | 137,812 | 85,730 | 97,604 | 4,232 | | |
| | Raco | 301,390 | 178,497 | 120,807 | 78,960 | 2,670 | | |
| | Moran | 201,784 | 141,686 | 113,661 | 245,511 | 7,663 | | |
| | Dukes | | | | | 544 | | |
| | Entire Forest | 1,325,186 | 765,869 | 544,742 | 594,981 | 18,759 | 5/11/45 | 1/1/55 |
| Clark | Fristo | 467,542 | 287,000 | 280,666 | 255,200 | 7,600 | 7/13/48 | |
| 891,404 Acres | Meramec | 771,365 | 353,988 | 347,575 | 38,239 | 2,400 | | |
| | St. Francois | 385,559 | 46,057 | 46,057 | 15,709 | 700 | | |
| | Wappapello | 347,419 | 136,176 | 127,068 | 7,837 | 750 | | |
| | Entire Forest | 1,971,885 | 823,221 | 801,364 | 316,985 | 11,450 | 4/17/42 | 1/1/51 |
| Mark Twain | Ava | | | | | 950 | | |
| 450,884 Acres | Cassville | | | | | 740 | | |
| | Houston | | | | | 1,340 | | |
| | Rolla | | | | | 700 | | |
| | Willow Springs | | | | | 2,370 | | |
| | Entire Forest | 1,349,628 | 412,262 | 384,213 | 131,965 | 6,100 | 1/9/41 | 1/1/51 |

REGION 9 - STATUS OF MANAGEMENT PLANS AND POLICY STATEMENTS.

| Forest | Working Circle | 1/ Gross Area Acres | 2/ Total Gov't. Area Acres | 2/ Commercial Forest Land Gov't.-Acres | 2/ Timber Volume MBM | 3/ Annual Allowable Cut - MBM | 3/ Plan Approved Date | 3/ Indicated Revision Date |
|---|---|---|---|---|---|---|---|---|
| Shawnee 217,621 Acres | Jonesboro | | | | | 2,600 | | |
| | Vienna | | | | | 625 | | |
| | Elizabethtown | | | | | 700 | | |
| | Entire Forest | 812,654 | 196,990 | 186,600 | 190,120 | 3,925 | 7/1/40 | 7/1/50 |
| Hoosier 105,340 Acres | Entire Forest | 781,467 | 80,184 | 78,986 | 18,271 | 1,000 | | |
| Wayne 99,652 Acres | Entire Forest | 1,466,109 | 76,682 | 72,042 | 90,497 | 1,000 | | |
| | Totals 52 | 18,531,359 | 7,767,359 | 6,825,193 | 8,183,622 | 304,148 | | |

1/ From management plans or policy statements where available. Hoosier and Wayne data from L-STATISTICS, General N.F. Area Report 7/1/48. Superior and Chippewa totals from Reappraisal Report.

2/ From Reappraisal Report, where not available from management plans or policy statements.

3/ From management plans or policy statements.

Note: Acres given under "Forests" represent total government owned acreage as of July 1, 1948 (L-STATISTICS, General 7/1/48)

Table 2.

Milwaukee 3, Wisconsin
March 17, 1949.

SUMMARY OF CURRENT MANAGEMENT PLAN SITUATION AND PLANNED PROGRAM FOR REGION 9.

| Forest | Working Circle | Area - Acres Gross | Area - Acres Gov't. | Date Present Plan Apprvd. | Planned Revision Date | Planned Management Plan Program - by F.Y. Date of New Photography | Completion Date of Survey | Completion Date Plans | Cost $ |
|---|---|---|---|---|---|---|---|---|---|
| Chippewa | Bena | | | 5/18/37 | 1/1/47 | | | F.Y. 1950 | |
| | Blackduck | | | 7/15/43 | 1/1/50 | | | F.Y. 1950 | |
| | Cass Lake | | | | | | | F.Y. 1949 | |
| | Dora Lake | | | | | | | F.Y. 1950 | |
| | Marcell | | | 11/15/45 | 7/1/55 | | | F.Y. 1951 | |
| | Remer | | | | | | | F.Y. 1951 | |
| | Walker | | | 3/11/47 | 7/1/55 | | | F.Y. 1951 | |
| | Cut Foot Sioux | | | 4/23/47 | 1/1/47 | | | F.Y. 1950 | |
| | Entire Forest | 1,313,459 | 591,685 | | | F.Y. 1948 | F.Y. 1949 | F.Y. 1951 | 70,000 |
| Superior | Cook | | | 12/31/36 | 1/1/46 | F.Y. 1949 | F.Y. 1951 | F.Y. 1951 | |
| | Big Lake | | | 3/29/39 | 1/1/47 | F.Y. 1950 | F.Y. 1952 | F.Y. 1952 | |
| | Kabetogama | | | | | F.Y. 1950 | F.Y. 1952 | F.Y. 1954 | |
| 1/ | Kawishiwi | | | 3/29/39 | 1/1/47 | F.Y. 1950 | F.Y. 1952 | F.Y. 1953 | |
| | Mesaba | | | 4/24/44 | 6/30/47 | F.Y. 1950 | F.Y. 1952 | F.Y. 1953 | |
| | Stony | | | 3/29/39 | 1/1/47 | F.Y. 1950 | F.Y. 1952 | F.Y. 1953 | |
| | Entire Forest | 3,727,540 | 2,035,766 | | | F.Y. 1950 | F.Y. 1952 | F.Y. 1954 | 150,000 |
| Chequamegon | Flambeau | | | | | | | F.Y. 1953 | |
| | Chippewa | | | | | | | F.Y. 1954 | |
| | Mondeaux | | | | | | | F.Y. 1954 | |
| | Moquah | | | | | | | F.Y. 1954 | |
| | Namekagon | | | | | | | F.Y. 1954 | |
| | Entire Forest | 1,031,000 | 816,540 | 9/15/42 | 1/1/52 | F.Y. 1951 | F.Y. 1953 | F.Y. 1954 | 50,000 |
| Nicolet | Argonne | | | | | | | F.Y. 1952 | |
| | Eagle River | | | | | | | F.Y. 1952 | |
| | Florence | | | | | | | F.Y. 1953 | |
| | Lakewood | | | | | | | F.Y. 1953 | |
| | Laona | | | | | | | F.Y. 1953 | |
| | Entire Forest | 985,376 | 629,595 | 8/18/47 | 7/1/53 | F.Y. 1951 | F.Y. 1952 | F.Y. 1953 | 45,000 |

Table 2.

SUMMARY OF CURRENT MANAGEMENT PLAN SITUATION AND PLANNED PROGRAM FOR REGION 9.

| Forest | Working Circle | Area - Acres Gross | Area - Acres Gov't. | Date Present Plan Apprvl. | Planned Revision Date | Planned Management Plan Program - by F.Y.: Date of New Photography | Completion Date of Survey | Completion Date Plans | Cost $ |
|---|---|---|---|---|---|---|---|---|---|
| Manistee | Baldwin | | | | | | | F.Y. 1956 | |
| Division | Cadillac | | | | | | | F.Y. 1956 | |
| Lower Michigan | Manistee | | | | | | | F.Y. 1956 | |
| | White Cloud | | | | | | | F.Y. 1956 | |
| | Manistee Div. | 1,254,855 | 344,228 | 9/4/41 | 11/1/45 | F.Y. 1954 | F.Y. 1955 | F.Y. 1956 | 50,000 |
| Huron | Mio | 324,300 | 189,100 | 5/1/40 | 1/1/45 | F.Y. 1949 | F.Y. 1950 | F.Y. 1950 | 16,000 |
| | Tawas | 444,900 | 187,200 | 12/17/38 | 1/1/45 | F.Y. 1949 | F.Y. 1950 | F.Y. 1950 | 22,000 |
| Ottawa | Iron River | | | | | | F.Y. 1949 | F.Y. 1950 | |
| | Kenton | | | | | | F.Y. 1949 | F.Y. 1950 | |
| | Watersmeet | | | | | | F.Y. 1950 | F.Y. 1950 | |
| | Ontonagon | | | | | | F.Y. 1950 | F.Y. 1951 | |
| | Bergland | | | | | | F.Y. 1950 | F.Y. 1951 | |
| | Bessemer | | | | | | F.Y. 1950 | F.Y. 1951 | |
| | Entire Forest | 1,743,000 | 791,594 | F.Y.1947 | 7/1/54 | F.Y. 1948 | F.Y. 1950 | F.Y. 1951 | 75,000 |
| Upper Michigan | Munising | | | | | | | F.Y. 1955 | |
| | Rapid River | | | | | | | F.Y. 1955 | |
| | Manistique | | | | | | | F.Y. 1955 | |
| | Raco | | | | | | | F.Y. 1955 | |
| | Moran | | | | | | | F.Y. 1954 | |
| | Entire Forest | 1,325,186 | 793,953 | 5/11/45 | 1/1/55 | F.Y. 1952 | F.Y. 1954 | F.Y. 1955 | 60,000 |
| Clark | Centerville | | | 4/17/42 | 1/1/51 | | F.Y. 1958 | F.Y. 1959 | |
| | Doniphan | | | 7/13/48 | 7/1/53 | | F.Y. 1957 | F.Y. 1958 | |
| 2/ | Fredericktown | | | 4/17/42 | 1/1/51 | | F.Y. 1958 | F.Y. 1959 | |
| | Poplar Bluff | | | 4/17/42 | 1/1/51 | | F.Y. 1957 | F.Y. 1958 | |
| | Potosi | | | 4/17/42 | 1/1/51 | | F.Y. 1958 | F.Y. 1959 | |
| | Salem | | | 4/17/42 | 1/1/51 | | F.Y. 1958 | F.Y. 1959 | |
| | Winona | | | 7/13/48 | 7/1/53 | | F.Y. 1957 | F.Y. 1958 | |
| | Entire Forest | 1,971,885 | 891,464 | | | F.Y. 1956 | F.Y. 1956 | F.Y. 1959 | 80,000 |
| Mark Twain | Ava | | | | | | F.Y. 1957 | F.Y. 1958 | |
| | Cassville | | | | | | F.Y. 1957 | F.Y. 1958 | |
| 2/ | Houston | | | | | | F.Y. 1956 | F.Y. 1957 | |
| | Rolla | | | | | | F.Y. 1956 | F.Y. 1957 | |
| | Willow Springs | | | | | | F.Y. 1956 | F.Y. 1957 | |
| | Entire Forest | 1,319,628 | 450,884 | 1/9/41 | 1/1/51 | F.Y. 1955 | F.Y. 1957 | F.Y. 1958 | 55,000 |

Table 2.

SUMMARY OF CURRENT MANAGEMENT PLAN SITUATION AND PLANNED PROGRAM FOR REGION 9.

| Forest | Working Circle | Area - Acres Gross | Area - Acres Gov't. | Date Present Plan Apprvd. | Planned Revision Date | Planned Management Plan Program - by F.Y. Date of New Photography | Completion Date of Survey | Completion Date Plans | Cost $ |
|---|---|---|---|---|---|---|---|---|---|
| Shawnee 2/ | Jonesboro | | | | | | F.Y. 1958 | F.Y.1959 | |
| | Vienna | | | | | | F.Y. 1959 | F.Y.1960 | |
| | Elizabethtown | | | | | | F.Y. 1959 | F.Y.1960 | |
| | Entire Forest | 812,654 | 217,621 | 7/1/[illegible] | 7/1/50 | F.Y. 1957 | F.Y. 1959 | F.Y.1960 | 35,000 |
| Hoosier 2/ | Entire Forest | 781,467 | 105,340 | Policy statement to be prepared by F.Y.1950 | | | | | 3,000 |
| Wayne 2/ | Entire Forest | 1,466,109 | 99,652 | " | " | " " | " " | " | 3,000 |
| Regional Total | 58 | | | | | | | | 714,000 |

1/ The Superior at present is divided into 6 working circles. A change will be made here and the final number may increase to 10.

2/ An extensive volume survey is under way on these Forests for the purpose of securing volume and growth data for plan revision and in the case of the Hoosier and Wayne for plan preparation.

# TIMBER MANAGEMENT PLANNING ON THE CARIBBEAN NATIONAL FOREST

William H. Cole - Forest Supervisor

The Caribbean National Forest is in an environment which differs considerably from other national forests. It seems necessary therefore in presenting the details of management planning in the Forest to first describe local conditions and the character of the stands.

## The Island of Puerto Rico

Puerto Rico is one of the West Indies, located about 1,400 miles southeast of New York and 965 miles southeast of the southern tip of Florida, in the Atlantic time zone. Its area of about 3,500 square miles is smaller than some of the western national forests, such as the Gila and the Flathead. The average winter temperature is 76°; summer, 80°. Extremes are 41° and 102°. Annual rainfall ranges from 25 inches on the southwest coast to 180 inches in the eastern mountains. Most of the island is mountainous, and the highest elevation is 4,400 feet.

The island was Spanish from the time of discovery in 1493 until the Spanish-American War in 1898. Its population has grown rapidly until it now stands at about 2,200,000, or one person per acre. The birth rate was 39 per 1,000 in 1940, as compared with 18 for the States. Two-thirds of the population is rural. Income is inadequate. Eighty-five percent of the families received an average annual income of $341 in 1940. The main crops are sugar cane and tobacco, with coffee third. There is little heavy industry.

The island was originally entirely covered with hardwood forest. No softwoods are native. More than 500 tree species are present. Compare this with 717 species for the United States, Canada, and Alaska. Thirty-eight

tree species of Puerto Rico are found in the United States but of these 35 are confined in the States to southern Florida.

Less than one percent of the island is covered with virgin forest. Some 420,000 acres, or nearly 20 percent of the island bear cutover forests. An additional 180,000 acres is dedicated to coffee plantations under tree shade, yielding posts and fuelwood as by-products.

## The Tropical Region

All work of the Federal Forest Service in Puerto Rico is combined under the Tropical Region. This is made up of the Tropical Forest Experiment Station, the Caribbean National Forest, and cooperation in forestry with the British, French, and Dutch possessions and the independent countries of the West Indies, Central, and South America.

A unique situation is the unified supervision of the Federal and Insular Forest Services. The Director of the Tropical Region is, by appointment of the Commissioner of Agriculture and Commerce, also Director of the Insular Forest Service. This arrangement where the top Federal Forest Service man has also been head of the Insular Service started in 1918 and has now run for 30 years under only a gentlemen's agreement between the Commissioner and our own Secretary of Agriculture. There are 12 Insular Forests of from 2,000 to 10,000 acres each scattered from one end of the island to the other, with a total area of 45,000 acres.

## The Caribbean National Forest

The Caribbean National Forest has developed from a nucleus which was originally a reserve of the Spanish Forest Service, set aside in about 1876. It was conceded by the Spanish Crown to the United States in the Treaty of Paris in 1898. It was proclaimed a forest reserve by Theodore Roosevelt in [illegible] species of [illegible] from [illegible] the United States being of these [illegible] in the island of Puerto Rico.

Less than [illegible] of the island are covered with [illegible] forest. Some 100,000 acres, or nearly [illegible] of the island [illegible]. An additional 190,000 acres is [illegible] under [illegible], yielding posts and fuelwood as by-products.

The Tropical Region

All work of the Federal Forest Service in Puerto Rico is combined under the Tropical Region. This is made up of the Tropical Forest Experiment Station, the Caribbean National Forest, and cooperation in forestry with the Insular Government and the independent countries of the West Indies, Central, and South America.

A unique situation is the unified organization of the Federal and Insular Forest Services. The Director of the Tropical Region is, by appointment of the Commissioner of Agriculture and Commerce, also Director of the Insular Forest Service. This arrangement began when the Federal Forest Service was the successor of the Insular Service started in 1918 and has run for 20 years under a continuous agreement between the Commissioner and the Secretary of Agriculture. There are 13 Insular Forests of from 2,000 to 15,000 acres each scattered from one end of the island to the other, with a total area of 41,000 acres.

The Caribbean National Forest

The Caribbean National Forest has developed from a Luquillo which was originally a reserve of the Spanish Forest Service, set aside in about 1876. It was transferred by the Spanish Crown to the United States by the Treaty of Paris in 1898. It was proclaimed a forest reserve by Theodore Roosevelt in

1903 but no supervisor was appointed until 1918. The area conceded by Spain was 12,400 acres. Subsequent land acquisition has increased the area to about 32,000 acres. There are now two Divisions, Luquillo in the eastern mountains and Toro Negro in the central mountains.

Twenty-eight percent of the area of the Forest is non-timber land. Included in this category are a natural area, an area for the protection of the nearly extinct Puerto Rican parrot, critical watershed areas, two recreation areas, and numerous small tracts suited to farming.

The commercial timber area of the Forest contains nearly 24,000 acres and some 230 species of trees. As many as 50 species may be found on one acre. Of these 230 species, 47 produce sawtimber; 63, poles; 96, fuelwood; and 24 are weeds. Stands vary considerably as to volume. The heaviest run to possibly 30,000 board feet per acre, but these are merely small groups of large trees. The average is below 3,000 board feet. About one third of the area is economically inaccessible at present.

Some 6,000 acres of deforested timber-lands have been planted. On the poorest sites difficulties of tree establishment have made it necessary to consider hardiness of the species more than the value of the first crop. Eucalyptus is promising under these conditions. On better sites Honduras mahogany grows well. A number of other less familiar species are also planted. Bamboo is being tried experimentally with six species.

## Local Factors of Importance to Forestry

A number of local factors have an important bearing on forestry. The most important of these are:

1. Dense population creates a high demand for forest products of all sorts, including saw timber, poles, crossties, posts,

[illegible] population [illegible] 1950 population of [illegible] was [illegible],000 [illegible]. [illegible] the [illegible] [illegible] in the [illegible] [illegible] [illegible].

Thirty-five percent of the area of the Forest is [illegible] timber land [illegible] in this category [illegible] [illegible] of the [illegible] [illegible] [illegible] areas, and numerous small private [illegible].

The commercial timber zone of the Forest contains nearly [illegible],000 acres and some 250 species of plants. As much as 50 percent may be found on the [illegible]. Of these 250 species, [illegible] and 24 are shrubs. [illegible] The [illegible] [illegible] [illegible]. The [illegible] is [illegible] [illegible] of the [illegible].

Some 5,000 acres of [illegible] have been planted. The [illegible] [illegible] have been made [illegible] [illegible] of the [illegible] [illegible] [illegible]. [illegible] are also [illegible]. [illegible].

Local [illegible]

A number of local [illegible] have [illegible]. The [illegible] of these are:

1. [illegible] [illegible] of all [illegible], [illegible],

oxcart yokes and tongues, stakes, fuelwood, leaves and grass for thatch, bark for rope, vines for basketry, and numerous fruits for human and animal consumption.

2. Most woods decay rapidly on the island and frequent replacement is necessary. Preservatives are little used.

3. Fuel is not needed for warmth in the winter, but faggots or charcoal are the cooking fuels for possibly half the population.

4. Forest growth is rapid.

The high demand for forest products makes possible intensive silviculture. Very few trees will not pay their way to market. The fuelwood demand places the limit of utilization at 1 inch. No slash is left. Rapid growth means high yields and quick response to silviculture.

Fundamentals of Management-Similar to the States

The fundamentals of timber management are as applicable in the Caribbean as elsewhere. The Timber Management Section of the Manual is sufficiently broad to apply directly almost without qualification. As in other national forests the overall objective is production for the needs of society as a whole with emphasis on local requirements. The goal is sawtimber production. The silvicultural objective of present cutting practice is the betterment of the growing stock both in species and in the balance between the different sizes, with a selection forest operated on a 5- or 10-year cycle as the goal. Working circles have been tied to the forest worker community and are defined by topographic features as in the States. Compartments are bounded by rivers, ridges, and type lines. The only possible method of budgeting the cut has been through control by area, since no reliable data on volumes have been available.

Details of Management - Different from the States

The great demand for forest products and the complexity of the forest make necessary certain differences in the details of management. Some of the more outstanding differences are:

1. The Caribbean is not subject to fires, so that fire control is not a feature of management.

2. Timber marking rules are complicated by the large number of species and the great variety of products. Little is known regarding the utilities of many species so that no grest degree of refinement of marking practice is possible.

3. The fact that woods workers walk to work means that working circles should be small if stable communities are to result. The average size of the working circles in the Caribbean is about 1,800 acres for timber production. Compartments average 200 acres.

4. The forest is so mixed that extraction of any one product or any one species involves removal of comparatively few trees from a large area. Sales must therefore be by amount rather than area. Sale areas are irregular and sales are small. During the past 5 years 4,700 individual sales were made involving 9,936 M feet of all products on about 6,300 acres.

5. Knutsen-Vandemberg funds cannot be used. Maintaining the identity of each sale area is impossible and innumerable suspense accounts would be involved. Cutting of weeds, vines, and worthless trees is thus impracticable through K-V at present.

6. Intense rainfall and step slopes require costly transportation facilities. Truck trails must be surfaced. Unsurfaced trails are satisfactory only for oxen and even these must be carefully drained.

7. Lumber values up to $300 per M Feet for the better species make practical single-tree logging. Pit-sawing is the rule. Sawtimber is so scattered and variable as to species that any sawmill large enough to handle the dense material cannot be provided with adequate volume, and finishing mills refuse to surface some species, due to hardness of the lumber.

Status of Management Planning

A policy statement was written for the forest in 1932. No revision or management plan has been made since, although the forest was cruised and a plan was begun toward the end of the 1930's. Cutting began on a large scale in 1943, using area as the only form of control. In 1945 a volume budget was added as a check to area control. This budget was based upon the average yield per acre from cuttings to that date.

A 3-percent recruise of the timber producing area is nearing completion. The cruisers recorded species d.b.h., total height, merchantable height of all trees of 4 inches d.b.h. or more. Those which should be cut in the first cycle were also indicated.

Volume tables have just been completed for merchantable stemwood volume and total cubic volume of the tree, following each branch cut to the 1-inch point. It is thus possible by subtraction to determine from the cruise data the respective sawtimber, polewood, and fuelwood volumes by species and whether to be cut or left. These data will be used as a

check on area control and as a basis for improvement in the first Transportation Plan, drawn up in 1945.

An estimate of future yields and the proper length of cutting cycles (now 5 years in one type and 10 years in the other) is being provided by a series of 25 growth plots ranging from 1/4 to 2 acres in size. Growth ring studies are not possible because there are no growth rings as a rule, and where there are they are probably not annual. Periodic remeasurement of tagged trees is therefore the only source of growth data. These data are being used to project forward the stand tables of the cruise. The rotation is unknown. Reproduction is considered generally adequate.

Timber management plan integrating timber production with other land uses and covering all 13 working circles but separated by Divisions of the Forest will be submitted to Washington during the coming fiscal year. This plan will include background information of permanent value in considerable detail. The general revision of the plan is proposed after 10 years, with an interim study of cutting rates and changed conditions at the end of 5 years.

In spite of the differences between the tropical forests of Puerto Rico and yours in the temperate zone there are many principles and premises of management planning that are common to both, and so we in the Tropical Region have looked forward to the discussions and findings of this Conference as a source of much help in resolving many of our management problems.

## Working Circles

Caribbean National Forest

| | Area - Acres | |
|---|---|---|
| | Total | Commercial timber land |
| **Luquillo Division** | | |
| Cubuy | 2,217 | 276 |
| Gurabo | 1,290 | 1,261 |
| La Mina | 4,601 | 1,815 |
| Cienaga Alta | 2,154 | 2,154 |
| Espíritu Santo | 3,232 | 2,068 |
| Jimenez | 2,091 | 1,896 |
| Cacique | 2,641 | 1,289 |
| Cristal | 2,086 | 2,075 |
| Fajardo | 2,814 | 1,961 |
| Hicaco | 3,275 | 2,897 |
| Subtotals | 26,401 | 17,692 |
| **Toro Negro Division** | | |
| Doña Juana | 1,084 | 730 |
| Matrullas | 776 | 705 |
| Guineo | 4,728 | 4,549 |
| Subtotals | 6,588 | 5,984 |
| **Grand totals** | 32,989 | 23,676 |

## ANNUAL CUTTING BUDGET FOR THE CARIBBEAN NATIONAL FOREST

### 1947-1952

| Working Circle | Sawtimber: Tabonuco | Sawtimber: Laurel Sabino | Sawtimber: Other Species | Sawtimber: Total | Posts, Poles Ties, etc. | Fuelwood |
|---|---|---|---|---|---|---|
| | M bd. ft. | M bd. ft. | M bd. ft. | M bd. ft. | M cu. ft. | Cords |
| **Luquillo Division** | | | | | | |
| Espíritu Santo | 29 | 6 | 12 | 47 | 11.5 | 1,260 |
| Cacique | 22 | 3 | 8 | 33 | 6.2 | 610 |
| Ciénaga Alta | 0 | 1 | 6 | 7 | 11.6 | 1,190 |
| Gurabo | 0 | 2 | 4 | 6 | 4.8 | 530 |
| Cubuy | 0 | 3 | 1 | 4 | 2.6 | 320 |
| Hicaco | 0 | 9 | 6 | 15 | 9.4 | 1,320 |
| Fajardo | 15 | 0 | 5 | 20 | 5.4 | 550 |
| Cristal | 34 | 0 | 3 | 37 | 12.0 | 1,160 |
| La Mina | 51 | 1 | 4 | 56 | 20.6 | 2,140 |
| Jimenez | 76 | 2 | 26 | 104 | 12.6 | 1,250 |
| Subtotals | 227 | 27 | 75 | 329 | 96.7 | 10,330 |
| **Toro Negro Division** | | | | | | |
| Doña Juana | 5 | - | - | 5 | 6.5 | 410 |
| Matrullas | 2 | - | - | 2 | 7.5 | 540 |
| Guineo | 0 | - | - | 0 | 11.4 | 1,410 |
| Subtotals | 7 | - | - | 7 | 25.4 | 2,360 |
| GRAND TOTALS | 234 | 27 | 75 | 336 | 122.1 | 12,690 |

S
SUPERVISION
Meetings
(Management Plan Conference)

March 23, 1949

# MANAGEMENT POLICY

B. O. HUGHES

Region 5

The objectives of management will vary as widely as do the special interests of the timber landowner. A farmer may be interested primarily in opportunities for off-season employment of farm labor. A wood-buying pulp mill might be interested in the bargaining advantage it gains by having an alternate source of raw material. A sawmill is interested primarily in insuring a source of logs to provide a profitable sawmill operation. And then there is the relatively small group that manages timberland to make a profit on the sale of stumpage. They are interested in the maximum return on their time and investment in timber growing. It is this group that has most in common with public timber managers. They are fundamentally tree growers, rather than processors who are growing timber by force of circumstances. However, the management of national forest timber is concerned with other objectives than the maximum return on time and investment, important as they may be.

Regulation S-3 states these objectives as follows:

"1. Aid in providing a continuous supply of national forest timber for the use and necessities of the citizens of the United States.

"2. Provide, so far as feasible, for the stabilization of communities and of opportunities for employment."

To intelligently carry out the first of these objectives requires a determination of national needs and the probable supply of raw material. Miscellaneous Publication No. 668 contains a great deal of useful information for this purpose. In brief, the balance between current growth and use, in

terms of cubic feet, is so close (13.7 billion cubic feet drain and 13.4 billion cubic feet growth) that a continuous supply of timber appears assured. However, when growth and use in sawlog material is compared it is apparent that use far exceeds growth (35 billion board feet growth and 54 billion board feet drain). Clearly the United States has too much of its total growth in small sizes and far too little in sawlog sized trees, if lumber is to continue to be in "continuous supply for the use and necessities of the citizens of the United States."

If this is the situation, the objective of national forest management should be growing sawtimber rather than cordwood. Actually this is over-simplification. The real shortage is in quality. It is in veneer logs and high grade sawlogs that the greatest unbalance between growth and needs will be found.

Every so often someone makes the statement that only the Government can afford to carry stands for the long rotations necessary to secure large sizes and high quality. Large sizes and high quality are not always the same thing. And artificial pruning will make it possible to grow high-grade sawlogs in short rotations, if long rotations are undesirable. Quite possibly both pruning and long rotations will be employed in many cases.

The statement has also been made that the chemical uses of wood will assume such importance in the future that cellulose production should be the main objective. It is not impossible that this may turn out to be true. On the other hand, it is possible that expansion of chemical uses will no more than absorb the tremendous volume of material that is now being wasted in the woods, mills, and in mortality in young, unthinned stands. In view of present and prospective markets for plastics the second possibility appears much more likely.

The second objective requires stabilization of communities and of opportunities for employment. A combination of a continuous supply of timber and a profitable industry with integrated utilization and a minimum of waste should meet this requirement. The problem arises when the condition of the stand is such that, from a silvicultural point of view, the excess growing stock should be reduced as rapidly as possible. This indicates a more rapid rate of cutting than can be maintained permanently. When the inevitable adjustment comes stabilization and employment will suffer.

One approach to this problem might be as follows:

1. Caluclate the rate of cutting which can be maintained permanently.
2. Compute the amount of employment which such a cut would provide, on the basis of primary manufacture only, and on the basis of a degree of refinement and re-manufacture carried on by some typical operations in the region.
3. Establish an allowable annual cut for the first cutting cycle which will not involve more employment in primary manufacture than would the sustained yield capacity with refinement and re-manufacture.

It might clarify this approach to work out an example: Assume that the sustained yield is 20 million feet a year, and that primary manufacture of this volume involves 250 jobs. Assume that the addition of a cut-up plant, moulding manufacture, box factory, sash and door plant, or similar facilities, would increase this to 375 jobs. This is the amount of employment which can be sustained and stabilized with an annual cut of 20 million feet and remanufacturing facilities. A cut of 30 million feet involving primary manufacture only would also involve 375 jobs. In other words if, in order to reduce an excess of growing stock, the allowable annual cut for the first cutting cycle were set at 30 million feet, it would be possible to drop to 20 million

feet later on and still sustain employment at the same level by adding remanufacturing facilities coincident with the reduction in rate of cutting. Community values would be protected.

There are other solutions of the same problem. One is to keep the allowable annual cut on a sustained yield basis separate in all calculations. The excess cut, whether it is primarily to anticipate mortality, or to reduce an excess of growing stock is then treated as a temporary arrangement.

If we use the same example, the allowable annual cut will be 20 million feet. An additional volume of 10 million feet will be offered annually on a temporary basis. There will be no excuse for establishing permanent community facilities or making other long-time commitments on the basis of this extra volume. A relatively small "breakdown" mill built in the woods might be one answer.

There is another situation for which there is no easy answer. Here there is a <u>deficiency</u> of growing stock.

From a silvicultural standpoint, the cut should be limited to material which is not good growing stock, and to stands which have the localized overstocking typical of many areas which are, in general, understocked. However, from the standpoint of community stability it might be better to include in the allowable annual cut some of the material which might otherwise go to build up growing stock. To the extent this diversion is made it will take longer to bring these stands to maximum productivity.

There appears to be no guide as to just how far to compromise. If a major re-organization of the established industrial set-up is inevitable there might be no point to postponing it. If, however, a portion of the present

facilities could be operated efficiently by providing an annual cut somewhat higher than pure silviculture would dictate, there might be a net gain in doing so. The disadvantage in delaying the rebuilding of growing stock could be more than compensated by the maintenance of continuous employment during the interval necessary for this rebuilding.

In conclusion we need to keep in mind that the lumber industry is often at least as dependent upon markets for stability of employment, as upon the source of raw material. Therefore community stability will not result automatically if a continuous source of stumpage is assured. Some types of mills are notoriously so wasteful and inefficient that they can operate only during periods of high prices. We should encourage, as far as possible, efficient operators who are well enough financed to maintain employment in the face of a fluctuating lumber market. We also want to encourage close utilization both in the woods and in the mill. By-products, such as lath, and utilization of short lengths not only increase profits but also increase employment. An operator with a variety of markets has an advantage and this is particularly true of a mill man who also operates a box factory or other manufacturing plant using lumber as raw material. When lumber prices are low he can market his lumber in the form of box shook, if that alternative is the more profitable. The profits from the box factory have kept some mills running during periods when they might otherwise have shut down.

B. O. HUGHES

## TOPIC 4*

## THE WORKING CIRCLE

## CONCEPT - BOUNDARIES - SUBDIVISIONS

### 1. INTRODUCTION

The review of books, bulletins, conference reports, manuals, etc. issued during the past several decades gives recognition to "working circles" with various subdivisions and fine definitions. Apparently the main reason for different definitions is that each author wished to be different. However, each definition has a common objective.

The source material primarily considered in this statement is SAF "Forest Terminology"; Regulation S-3 (GA-A3(7)); Sub-Part 1, Part 3, Chapter 2 and particularly Sections 203.2 through 203.5, of the review draft of the Manual revision; and the review edition of "Timber Management Plans on the National Forests" by L. S. Gross.

### 2. A WORKING CIRCLE

The technical definition in SAF "Forest Terminology", i.e. "A forest area from which a sustained yield of forest products is planned" is satisfactory for our use. Objectives and policies can and should be considered and established administratively under the technical definition.

Regulation S-3 defines five major policies which are to be adhered to in considering a working circle and preparing a plan of management therefor. Section 203.4 of the proposed Manual revision includes three major items or objectives which should be considered in order to accomplish Regulation S-3 policies. They are:

(1) Afford maximum employment opportunities and stability to dependent communities (logging or manufacturing or both).

(2) Present or potential usable transportation arteries in relation to topography and dependent communities.

(3) Sufficient productive capacity for practicable sustained yield.

*For presentation at Hot Springs Conference - March 28-April 8, 1949

The foregoing satisfactorily covers the situation from a Service-wide standpoint and appropriately should be included in Service manuals. Further guides, detailed descriptions and suggestions should be included in the proposed "Timber Management Plans on the National Forests" (as they are in the review edition). Further interpretation should be optional with the Regional Forester.

Working circles are needed to break up a large forest property in order to attain Service objectives, particularly that of community stabilization; to facilitate efficient administrative management and to insure skillful or intensive timber management including sustained yield. A working circle could include one or more national forests or a Region if there were no interest in or concern about employment opportunities, community stabilization, steady 25 percent contributions to Counties, an integrated stable industry, continuous use of transportation facilities and other capital investments, and a stable volume of work for local forest managers. Such a concept is obviously not in the public interest. Except for a few unusual cases the same is true, but to a lesser degree, for Forest-wide management. The national forest working circle should be established to meet the prescribed objectives and the long-time Service concepts of timber management.

Except for broad historical or condition descriptions which, in many cases, should be made on a Forest-wide basis, a management plan should be written for each working circle. It is the best method whereby on-the-ground intensive management will be obtained unit by unit. Regional timber summaries or analyses may be needed and prepared for other reasons, but they cannot replace the unit management plan.

## 3. WORKING CIRCLE BOUNDARIES

In delineating a working circle boundary the objectives, discussed above, should be given primary consideration. A number of other items, depending on the individual case, should be considered or thoroughly analyzed. A few items are:

a. Acquisition possibilities including Forest boundary extensions.

b. Administrative boundaries, particularly Ranger Districts, and work loads.

c. Relation to other uses on the national forest.

d. Distribution of timber types and age classes and condition of the stand including large scale cultural operations.

e. Location of existing or potential industrial plants suitable for using the available forest products from the working circle.

f. Opportunities for all-season harvesting operations.

g. Adequacy of logging community sites (some working circles)

h. Small sawmills in the woods vs. transporting raw products to central points.

i. Possible allowable cut in relation to capital investment required for highly efficient or special plants.

The yield by a number of different classes of products must be given major attention in the establishment of many working circles and gradually on most of them. High grade logs may go to a plywood plant, low grade logs to a sawmill, small stem thinnings or certain species to a pulp plant, certain hardwood species to turning plants and so on. Some plants, such as large plywood or pulp plants, may obtain supplies from several working circles or several national forests which will necessitate the coordination of management plans and sales programs. An open log market (only a few in the Nation) is somewhat the same situation except all of the products may be cut and sold by one purchaser in contrast to making separate sales by class of products. These conditions will be affected far more by the coordination of plans and timber sales than by working circle boundaries and in such cases the attention to dependency will often largely be based on stable employment opportunities locally for harvest workers.

The planned location, relocation or abandonment of highways or railroads need special consideration as does the location of large storage dams, particularly in rough country, in establishing working circle boundaries.

Where the growing stock is being built up or there are no transportation or topographic hurdles the working circle boundary can often be arbitrarily placed on the Ranger District boundary, at least temporarily. Through the sales program there will be an opportunity to maintain a steady flow of harvestable products to dependent communities.

After full consideration is given to all analyzable factors the working circle boundary should be established on boundaries easily described and discernible on maps and on the ground. It is apparent that working circle boundaries should become permanent. Working circle boundaries should not be switched around at will; any revisions should be based on justifiable reasons. Community dependence upon a steady flow of forest products is an established fact. There is also the mechanical problem of changing management records and the technical problem of maintaining, in a given management unit, a suitable balance of growing stock if changes are made after the management program has run for any appreciable length of time. Management unit boundaries will become even more inviolate as time passes, and properly so.

There is a definite exception to the foregoing in some Eastern units where decrepit acquired forests are being "built up" or where acquisition programs have not been completed. There should be no insistence in such cases that permanent working circle boundaries be established at this time; timber management plans can be based on administrative units such as a Ranger District for an interim period.

## 4. WORKING CIRCLE SUB-DIVISIONS

In the past many working circles have been formalized by numerous sub-divisions and management plans tied thereto in various ways with only limited value, particularly during the initial harvest cut in virgin stands. The delineations have undoubtedly cost far more than they have been worth. An old-time forester recently said, "The bulldozer has eliminated blocks and compartments." It is apparent that the use of working circle sub-divisions must be justifiable when used, in contrast to making use of them because of habit or past practices.

The "block" is a major sub-division of a large working circle. Larry Gross* says "unless there are clear reasons for use of this sub-division, blocks should not be recognized...." He gives a few examples of desirable use. We agree with him but would suggest that block sub-divisions may also be useful in large rough Western working circles to define by "names" main sub-drainages. Some major sub-divisions are needed not only to provide "names" but also to delineate broad statistical material which serves to tie down main roads in transportation planning.

The "compartment" is a smaller sub-division useful for applying intensive timber management methods or practices or as a definite planning unit. Again Larry Gross* cites examples of desirable use. Their use should mainly be confined to working circles being intensively managed or where intensive management is apparent within the planning period. The use of compartments must be justified on the basis of definite need by the unit manager and balanced against planning and "bookkeeping" costs.

Finer sub-divisions than blocks and compartments are not needed in management planning. The two sub-divisions are adequate for use on the national forests.

---

*In "Timber Management Plans on the National Forests"

## 5. COMMUNITY SUPPORT (STABILITY)

More and more the national forests are contributing their just share to supplying the Nation's wood requirements - both in the West where the harvest of virgin stands is approaching sustained yield and in the East where acquired forests are producing increasing high value yields. National forest timber cutting is becoming big business and is bound to increase in size and importance. As the business becomes big the livelihood of more people becomes tied to it. Likewise, certain businesses, with large capital investments in plants and harvesting facilities, become more and more dependent on national forest timber - for many, they are wholly dependent. Increasingly, Forest Service administrators have the responsibility of so managing national forest timber that dependent communities, with all the implications, are not disrupted by unwarranted management revisions.

Our first and main responsibility is to make available a stable sustained flow of usable wood products from a given unit. That responsibility must not be overlooked in establishing or revising working circle boundaries, developing transportation arteries, preparation of management plans and conducting sales programs. Suffice to say, under this topic, that the permanent establishment of working circle boundaries is of major importance in the long run to a large number of people and merits special attention and consideration. Such is true whether the objective is the stability of dependent harvesting communities, manufacturing or processing communities, or both. The objective may, of course, vary widely between areas with specialized industries, open log markets, excess plant capacities, or with diversified ownerships in contrast to the interior forest community with a small custom sawmill wholly dependent on national forest timber. Each case will have to be decided on its individual merits.

## 6. ADMINISTRATIVE CORRELATION

The Forest Service is organized on the basis of local on-the-ground administration by the District Ranger. It is, therefore, highly important that correlation between Ranger District and working circle boundaries be achieved. A Ranger District might include more than one working circle, but it should not include one working circle and part of another. If, in order to accomplish this objective, it is necessary for one type of boundary to yield, the administrative boundary should be adjusted to fit the working circle boundary rather than vice versa.

Unfortunately, there will have to be exceptions to the objective, but they should be infrequent. In a few cases logical working circles will be too large to be administered by a District Ranger. Likewise, in a few instances other uses than timber management will take priority and govern the location of the Ranger District boundary.

## 7. OTHER OWNERSHIP CORRELATION

Where cooperative sustained yield units may realistically be anticipated it would be desirable to correlate forest management programs for the national forest and adjacent ownerships. Otherwise, the forest resource on national forests will largely have to be managed independently of other ownerships. Private lands or other public lands, adjacent or intermingled, create problems which are a deterrent to fully accomplishing the ideal objectives in the field of forest management but, as a rule, there is little that can be done about it. Consequently, it is advisable to manage national forest lands and timber to the best advantage of the public as an entity unto themselves. This does not mean that every possible means should not be considered to correlate management with other forest owners, but we should go ahead independently in the interim. This may mean condemnation of road rights-of-way to make national forest timber accessible; it may mean extensive land and timber exchanges to consolidate ownerships; and it may mean contributing to an already excessive overcut, all ownerships considered, in some production areas. Regardless of disadvantages involved, the time has passed when the Forest Service should wait for the arrival of some favorable circumstance in the indefinite future before initiating real programs of management on national forest lands for which it is administratively responsible.

## 8. SUMMARY

Working circles should be permanently established to conform to the policies and objectives set forth (or to be set forth) in the Manual. They should include a forest area of such size that local dependent communities will be afforded maximum stabilization, contain sufficient productive capacity for practicable sustained yield, and be given intensive management by an on-the-ground administrator. The use of working circle sub-divisions must be justified on the basis of definite need by the unit manager. To the extent possible Ranger District and working circle boundaries should be correlated. Except where there are immediate possibilities of correlated timber management between national forest and other intermingled or adjacent properties, national forest timber should be managed independently as an entity and without delay.

Assignees:

Lindh - R-3
Kirkpatrick - R-6
Sump - R-9

S
PLANS - R-2
Timber Management

March 7, 1949

# MANAGEMENT PLAN CONFERENCE - TOPIC #5

## Objectives of Management, Coordination with Other Uses

by Theodore Krueger

There should be general agreement, I believe, on the dictum that the type of forest management to be practiced on any piece of forest land, large or small, private or public, depends upon the objectives it is to fulfill or the purposes it is to serve.

From the overall point of view, there are a number of objectives to be considered in Timber Management planning, including:

National objectives,
Regional objectives, and
Local objectives;
Objectives for managing timber on public forest lands, such as National Forests; and objectives for managing timber on private lands.

These are all important. The primary objectives determine the type of timber management one can practice and the kind of plan he must prepare for it. In Region 2, because of its tremendous importance in water production for some of the western States, not maximum timber production but an overall Regional objective of watershed protection and production of usable water becomes the main consideration for the management of our timber and other resources.

The Region 2 policy states that "consideration of sound watershed management must underlie and influence all other uses of National Forest lands and surface resources within Forest Service control." Other Regions and localities have other primary and local objectives, and, in my opinion, there should not be any high degree of standardization of objectives. It would not be practical or desirable.

The objectives for the management of each and every working circle should be varied to fit its position in the general picture. The objectives for the management of every working circle must be varied to fit physical conditions of site and accessibility, and each one should be adjusted to the social and economic environment.

Assuming that the general, National objective of Federal forestry is to supplement private forestry and not to take its place, National Forest Working Circles in the better timber-producing areas should be managed for the production of quality rather than quantity. Private enterprise, with its generally better sites at lower altitudes, can produce maximum volume on shorter rotations, but there are National

Forest Working Circles where maximum volume or maximum dollar return should be emphasized; however, I do not believe that for the National Forest system as a whole, the profit-from-timber motive should be rated very high, as our objective of management.

There should be some working circles to be used to demonstrate the practicability of forestry to other owners. The Nebraska Forest is an example; the primary objective in establishment of this Forest was to make it serve as an example of what can be done by way of planting on private lands in the 20,000 square mile area of the sandhills.

There are working circles which, because of location of paper mills or other wood using industries, would serve their highest use if devoted entirely to the production of pulpwood or other special products to sustain the local industry.

At the other extreme, there are working circles in the West which are dependent upon markets several thousand miles away in the East and middle western States.

The small size to which it is possible to grow some trees, such as lodgepole pine in Region 2, cause some of our working circles to be necessarily devoted entirely to the production of ties, posts, poles, mine timbers, and a small amount of low grade lumber for local use. There may be other working circles in which the timber is largely of the pinon-juniper type, with local demand the only available outlet.

There is one overall Timber Management objective in our western Forests which aims to convert the virgin forests as quickly as possible into managed forests. Conversion, however, must be consistent with other objectives of management. On page 5 of the proposed "Instructions for Preparation of Timber Management Plans on the National Forests," Gross says:

> "The objective should be to plan for the greatest practicable use of the growing capacity of the soil."

All of this sums up to the conclusion that there cannot be any high degree of standardization of objectives.

In planning the management of one of our western working circles, we generally have to consider more than only the timber use or maximum possible production of timber. The Manual instructions (203.6) provide that coordination with other activities should be obtained at the Regional level and provide for referring proposed plans to other Resource Divisions for review.

"Forestry Terminology," issued by the Society of American Foresters in 1944, defines a Management Plan as:

"1. A written prescription to be followed in applying business methods and technical principles to the production of forest or other crops and services of all kinds on a specific area.

"2. A plan limiting or regulating the cut on a given administrative working circle."

This definition, under 1, recognizes the various resources and services of the Forest. Under 2, it refers specifically to timber.

The Chief's report for 1948 states that the "Multiple Use" principle was endorsed by the House Committee on Public Lands following a series of hearings in western States. This principle has been established as one of the guiding rules of the Forest Service and is recognized in Sections 206.1 to 206.7 of the proposed new Timber Management title of the Manual. The question arises, however: how far can we go in multiple use on any area, considering timber production?

Let us consider some of these multiple uses as they affect Timber Management planning.

Watershed Protection

Region 2 can well serve for illustration. Almost every acre of forest land here has a major influence on water supplies used throughout much of the West. We produce about 20 million acre feet of water annually, only 1/4 of which is used within the Region; the rest is used through the arid western States. For example, the Colorado River supplies water to Utah, New Mexico, Arizona, and California. It has been estimated that the annual yield of water from the forested watersheds of the Central Rockies is worth from 35 to 40 million dollars. It would seem apparent, therefore, that proper watershed management affects all of our working circle plans. As an example, on the Pike National Forest, with its loose granitic soils and extremely high watershed value, even though cutting would be silviculturally desirable and there is a good local market available for lumber, the timber on about 1/3 of the Forest can't be included in the allowable cut, as the only way to hold that soil is to get a leaf mulch on it and not disturb it by logging.

On important watersheds in the Engelmann spruce-fir type, a group cutting or partial cut system will serve the needs of watershed management best.

Recreation areas, roadside strips, and wilderness areas all require other calculations of cut than growth and yield; yet, they are recognized uses of the forest and must be considered in making a Timber Management plan. We can't cut in wilderness areas, for example, even to salvage bug-killed timber, unless we first hold a public hearing and get a revision of the policy for that wilderness area. A wilderness area may also restrict logging or the size of the

mills on the remainder of the working circle. I do not believe that it is necessary to exclude timber operations on recreation areas, roadside strips, camp grounds, or scenic areas. It is necessary, however, to modify our cutting practices, and this generally means a light partial cut rather than a cut based on the productive capacity of the soil.

Grazing

Moderate grazing use by domestic livestock or by game can, I believe, be coordinated with proper timber use without excluding grazing; however, there are a number of conflicts which can generally be adjusted; for example, grazing and planting do not mix well. Grazing by livestock or game in places has to be reduced at least temporarily to prevent excessive damage to reproduction or young growth. Then, we also have the question of the high spruce burn: should it be planted to trees or left for range?

Research Notes (No. 49 January 20, 1949) of the Pacific Northwest Station advocates the seeding to grasses of logging roads as an effective method for stabilizing soil and increasing production of forage. In the Black Hills, natural seeding of grass keeps some logging roads open for the next cut, is of help in fire control, and furnishes some forage between cuts.

Wildlife Management

Forests furnish food and shelter for game, and the correlation of forest management and wildlife management practices is receiving increased attention throughout the country. I believe that maintenance of satisfactory habitats for game and fish can be correlated with Timber Management activities.

There are many points of common interest; for example:

1. Roads constructed by timber operators or by the Forest Service for timber use are also used by hunters and fishermen, although heavily used timber roads may have to be closed to all but timber use for part of the year.

2. Clearings made by timber operations provide desirable variation in wildlife habitat.

3. Timber cover and cutting practices that protect the watershed also stabilize runoff for many miles of trout stream.

Timber Management plans recognize this needed correlation to an increasing extent. To illustrate:

1. The North Kaibab Working Circle plan in Region 3, completed in 1948, includes such practices as

   a. Cutting aspen to encourage sprouting.

b. In dense ponderosa pine, with no openings for a half mile or more, areas of 1/2 to 1 acre of overmature trees without reproduction are clearcut to see if it will increase deer browse and, at the same time, let reproduction come in.

2. On the Allegheny Forest in northwestern Pennsylvania with large acreages of second growth hardwoods, marking rules provide:

   a. For marking a strip 1 chain wide along streamsides in such manner as to give aquatic values first priority.

   b. Common apple, mountain ash, butternut, serviceberry, black gum, and trees supporting wild grapevines are not cut.

   c. An average of 1 den tree per acre is left.

   d. Clearcuttings of up to one acre in size for game food are considered in large unbroken areas of second growth.

In the Lake States, I understand, there are some areas of open grassland that would grow forest products but have not been planted because they provide suitable habitat for sharp tailed grouse, and some areas of browse have been excluded from areas to be planted. In our Region 2 Forests (and this, perhaps, applies to other western Regions) we have many natural open parks in the timber that are of high value to game, and we create other openings by logging operations. We retain forest cover on the banks of fishing streams; thinning operations in young stands are of value to game; and we are considering leaving some oak brush areas for game instead of planting them.

We have to realize that due partly to a tendency to impose restrictions against the use of private land and water, and an increased interest in hunting and fishing, the National Forests and other public lands are assuming increased importance, and coordination of timber use and wildlife use becomes a necessity. We can't ignore it. It is estimated that 4½ million hunters and fishermen used the National Forests in 1947.

How far can we or should we go in Timber Management plans to encourage game is a question which has not been answered. It needs to be decided for each individual working circle. Personally, I believe that the designation of forested areas for the primary purpose of wildlife management is seldom justified. I further believe that it is seldom necessary, as adjustments can usually be made to correlate wildlife needs with effective silviculture.

Research

In applying multiple use to forest lands, a process of trial and error is not efficient or desirable. Systematic research carried on partly at Experimental Forests and natural or other areas should provide the administrator with information on the effects of various miltiple uses on timber production under various conditions in order that he may plan each working circle for the maximum multiple benefits.

## Summary

To sum up, I believe that by proper coordination we can grow trees for use on land that is also of high value for water, wildlife, grazing, and recreation. We have merely made a beginning in multiple use of forest lands. Our objective should be the greatest good to the greatest number in the long run. Standardization and exclusive use will not make our National Forest Working Circles produce the greatest good.

Crossett, Arkansas
March 17, 1949

# OBJECTIVES OF NATIONAL FOREST TIMBER MANAGEMENT

R. R. Reynolds, Forester
Southern Forest Experiment Station

One could list a large number of objectives to aim for in the management of National Forest or, in fact, any forest land. In some cases it may be the production of high-grade sawlogs; in others, production of pulpwood, poles and piling; in others, it may be recreation, water or game; and in some, the main objective may be to use the area to hold the world together. If we scrutinize the subject closely, however, I think we will find that all these objectives have a common denominator. I think that we will find that there is really only one objective to the management of any land. It can be stated in some such fashion as this: "Regardless of location, the objective of management should be to attain the greatest possible public benefits the site is capable of producing."

In some cases management to control water supplies or to regulate stream flow provides, by far, the greatest returns. In other cases, recreation provides the highest possible use for a given piece of land. In still other cases, grazing may provide the best over-all return per dollar of investment. I have no objection to multiple use. Where two objectives are compatible and the return in dollars or in public benefit will be greater than from one management objective--well and good. We should take advantage of such possibilities. Since I am not well versed in watershed conditions and values and know very little about areas where grazing or other uses are of primary importance, I would like to limit my few remarks to that portion of the National Forests that are clearly of primary importance for timber management.

On such areas I believe that sooner or later we must make a choice of management objectives for any given area where multiple use results in poor returns. For example, due to heavy cutting and burning in the past there are many open grass areas in our southern forests. At the present time grazing of such areas is very desirable because this extra return is needed to keep the forest enterprise liquid. However, if the site is good, if we are good timber managers and rebuild our timber stands to good stocking, we must expect that the trees will soon crowd out the grass and the grazing. On the other hand, if our primary objective is to raise stock then we must use fire or some other means to keep the stands open.

Hogs and deer do well on oak mast and theoretically hog raising and timber farming can go hand in hand. In reality, however, most of the oaks that provide the mast on the pine uplands are of very low grade and are producing little or no timber return. At the same time they are reducing the possible pine growth by perhaps one-half over large areas. Again we must make a choice. We either can have hogs and get little returns from timber management or we can have timber and do away with the hogs.

If we subtract areas that are of more value for uses other than timber management from the total area of National Forests, a considerable area of land will still be available for timber production purposes. At least we have always assumed that it should be used for the growing of trees, However, I wonder if our thinking on this subject is too good? Too often, it seems to me, we have said in substance that after the land wanted for farms is subtracted from the total land area, after the land needed for pasture, recreation, water production, game production, roads, towns, streams, lakes and for all other uses anyone can think of is deducted from the total land area of the country, what is left is "forest land" and we should manage it for timber production.

It seems to me that accepting this philosophy has given forestry numerous black eyes in the past and will give us many more in the future. Much of our so-called forest land is low in productive possibilities. Regardless of what we spend on it the timber yields will be low and much land will never repay the investment we make. We should remember two things; (1) in the foreseeable future we will not need all the so-called forest land to produce all of our expected requirements for forest products assuming full productivity, and (2) much land now in farms or being farmed will produce greater returns from timber than from row crops, and much of it has recently been or soon will be returned to timber production. If we can accept these statements and also accept the fact that we do not have sufficient funds with which to intensively manage our lands it seems only good business to concentrate our efforts on our best land first.

I well realize that we cannot concentrate our efforts in the two or three regions of the country that have the best timber growth possibilities. Neither can we limit our efforts to a few forests in a given region. At the same time, to a considerable extent, we can concentrate a large proportion of our efforts to those portions of a forest that contain the better sites. By doing so we not only will produce more products needed by local industry but also we will produce more jobs, more returns to the counties and a higher standard of living for the territory.

I know that we have many areas of good forest land, on which tree farming is the highest possible use, that we are not managing intensively. In many cases we are getting only $1.00 return from $1.00 of investment whereas we can and should be getting $3.00 or $4.00 or $5.00 of return for every dollar we invest. To me it seems only reasonable that we should get the largest possible returns from the good areas before we go into the areas that will return only $0.50 or $1.00 for each $1.00 of investment. In fact, we may never be justified in attempting management on these poor areas. Perhaps we should face the facts and do nothing on the very poor sites--just provide fire protection or insure site stablization.

This, then, means that we need to study our lands and classify them. In some cases it may mean that some apparently hopeless areas need to receive some attention before other better looking areas. It may mean that an investment of $5.00 per acre in stand improvement in some cases will pay off better than a $1.00 per acre investment in others. It means that we must think in terms of one man managing 5,000 to 10,000 acres instead of 100,000 or 200,000 acres in many cases. I well realize that we often are not in a position to accept the choice. At the same time, now is a good time to begin to chart our course.

If we can go in for intensive management of our better sites we should do everything possible to get everything possible out of them. On and off National Forests, we often have allowed stands to stagnate, low-grade species to take over much of the effective growing space, or have failed to do any cutting because there was not much volume per acre. As a result our growth rate may have been very low and we have been utilizing only a very small amount of the productive possibilities of the area. For example, according to the Forest Survey the average board-foot growth for the unmanaged shortleaf-loblolly pine sites of southern Arkansas is 135 board feet per acre per year. What would you guess the growth on managed stands of this type and area would be--200? We don't know for sure but a selective timber management study that has been underway on the Crossett Experimental Forest for the last 10 years gives us some leads.

During the 10 years between 1937 and 1946 an average of 1,755 board feet (International 1/4-inch rule) of pine logs has been cut per acre from the study area. The average volume per acre in trees 12 inches and above before cutting started in 1937 was 4,807 board feet. Even though 1,755 board feet had been cut the average volume in 1946 was 6,253 board feet. Thus, even though 37 percent of the original volume was cut during the 10-year period, the stands increased in volume by 30 percent. The growth per acre per year has been 320 board feet and we know we have not even come close to the maximum possible. Of more importance, perhaps, is the fact that partly as a result of the harvest cutting that has been done over the last 10 years, and partly as a result of the improvement cutting that was done, the pine growth has increased by about 100 board feet per acre per year during the period.

I realize that the reason we have not always obtained similar cuts, increases in growing stock, and growth increases on similar sites on the National Forests is, in many cases, because we have not had the money or manpower to do the management job. I also realize, however, that part is due to the fact that we have been reluctant to cut a tree from any stand unless the tree was a poor risk.

In some instances the fact that the stand was not "fully stocked" has been responsible for our policy of very light cuts of only defective timber. We should not, however, allow this policy to restrict growth to only 200 board feet or less per acre per year on areas fully capable of producing 500 or more board feet per acre per year. Certain near mature but otherwise perfectly good trees in dense groups need to be removed from understocked stands at periodic intervals in order to obtain maximum growth of the stand. Consequently, removal of a considerable volume of good trees from our understocked stands is often necessary if we are to obtain maximum production.

Actually, we do not know the amount of stocking that is necessary for maximum growth. We do know that it will be considerably less for shortleaf and loblolly pine, managed in all-aged stands, than the "normal" as given in the yield tables. Our experience has been that the yield table "normal" stands will produce considerably less growth than more lightly stocked stands so there apparently is no reason for attempting to develop such heavily stocked stands. In our all-aged selection management of shortleaf-loblolly pine stands a stocking of perhaps one-third to one-half of yield table "normal" stocking will probably give us maximum growth.

It seems to me that we are also worrying too much about future markets, future distribution of tree sizes, rotations, transportation and long-time and over-all objectives and too little about today's work and possibilities. We actually know very little about the future and find that we can't even guess what will happen 10 years hence although we are spending a lot of time talking and planning for events that will happen 100 years in the future.

Too, markets and demand for certain sizes and certain products of the forest are constantly changing. Who knows what we will be called on to produce 50 years hence. It seems to me that if we attempt to grow good material of relatively large size we can take care of any market that may be available when the trees are mature. If we grow this kind of material, we can sell it on any kind of market.

Let us remember that regardless of whether we are managing public land or private land we sooner or later must justify any expenditures we make by the public benefits we provide. Let us then:

(1) Concentrate our timber management efforts on our better sites within our forest, giving the poorer areas fire and site protection only.

(2) All other things considered, revamp our marking and management policy so that maximum returns will be obtained.

(3) Manage our good areas intensively so that we can look forward to an average growth rate that approaches maximum potential of the site.

(4) Prepare management plans to take care of immediate needs--say 10 or 15 years--and eliminate unnecessary detail.

* * * * * * *

NORTHEASTERN FOREST EXPERIMENT STATION
Upper Darby, Pa.

R-NE
SUPERVISION
Meetings
Management Plan Conference
March 28-April 8, 1949

March 24, 1949

Topic 5.--Objectives of Management; Coordination with Other Uses

## Timber Reserves for Future National Emergencies

A review of "Timber Management Plans on the National Forests" leads me to raise a question as to the adequacy of management objectives set up therein. I am thinking specifically of the desirability of managing blocks in our national forests to provide reserves of material available for the more exacting war requirements. This added objective need in no way alter the broad objectives set up for national forests. It does, however, inject new considerations in setting up objectives for specific working circles on a number of national forests. Little if any consideration has been given to the possible contribution working circles can and should make to meet future national emergencies. All management plans should be appraised from this point of view.

Industry, because of economic considerations, cannot be expected to direct production primarily to the needs and welfare of the government. National forests being public investments should serve primarily the needs of the government, thus redeeming their responsibilities to the public.

Specifically, I believe that areas should be set aside in our eastern, western and Alaskan forests for the production of spruce airplane stock as well as areas for the production of high grade yellow birch veneer stock used in airplane manufacture and the construction of PT boats. Areas selected should be on highly productive sites and readily accessible. If areas on the White Mountain National Forest had been dedicated to spruce airplane production 25 to 30 years ago they might have made valuable contributions to World War II. Fortunately we were able to fall back on our Pacific coast and Alaskan forests for high grade spruce stock. The last war, however, made heavy inroads on these forests for such material. Hence it is not too early to make provision for a future emergency.

In like manner certain other national forests could well devote areas to the production of large size, high quality oak for ship timbers and non-magnetic mine sweepers, gun stock material, special grades of naval stores, top quality piling, truck body squares and other products. In fact it may be desirable to establish new national forest units in regions whose soil and climate are favorable to the production of specialized products particularly needed by the nation during an emergency.

All of such units should receive special care, thinnings and other cultural measures should be directed to the production of well formed, uniform growing trees to meet unique specifications. The objectives of specialized wood products cannot be attained by "overall" good silviculture. War has become highly specialized, hence demands highly specialized products. Failure of these products to fully meet requirements may mean construction of equipment inferior to that produced by the enemy. World War II has shown time and again what superior equipment means in the successful conduct of a war.

The best airplane fuselage during World War II was made of yellow birch which met certain specifications with regard to specific gravity, grain, number of rings per inch, degree of stain, shake, warp, knots, etc. For gunstock, ship timbers, etc., other species and a different set of specifications were demanded. Under nature's haphazard methods scarcely one tree in a hundred would meet the specifications demanded, and less than one in a thousand would meet the ideal. Is it not the responsibility of national forests to grow timber stands meeting such specifications and on a much more successful basis than nature will under a mere regime of overall good silviculture?

This constitutes a real challenge to foresters and will require the skill and application of the best forestry brains in the country. It calls for highly refined silviculture involving pruning as well as thinnings, and release cuttings of just the right intensity to achieve a crown density and distribution of stems which will insure attaining specified rates of growth, certain specific gravities, etc. to meet the exacting demands of war products. And what agency is better equipped with forests and personnel to undertake this task than the United States Forest Service with its array of national forests dedicated to the country's welfare and embracing a wide range of tree species and soil and climatic conditions?

M. Westveld

S
SUPERVISION
Meetings
Management Plan Conference

TOPIC 6

# BASIC DATA NEEDED FOR TIMBER MANAGEMENT PLANS

The needs for additional timber management plans in each of the National Forest Regions, discussed during the first day of this conference, clearly emphasizes the fact that the job of writing, revising and maintaining management plans for nearly 700 National Forest Working Circles involves a continuous work load of considerable proportion. The cost and effort incident to the collection of a great amount of detailed information and data often considered necessary, has frequently discouraged an earnest attempt to obtain it. In many instances, this viewpoint has resulted in no plan. If the task of collecting data and information, and the writing of a management plan is actually too great for our busy Supervisors and Rangers to undertake, even with some assistance and help, the results will frequently be that few plans will be prepared. With these conditions in mind and in view of our present rather limited funds for management plan work, it is highly important that this conference give careful consideration to the simplification and streamlining of plans.

It seems obvious that management on a considerable portion of our wild forest lands will be relatively extensive for a number of years and that intensive management will be confined largely to the best and most accessible sites for the present. How best to take our working circles apart, prescribe simply for each set of conditions as they now exist, tie this into the needs of local people and provide for periodic revision, seems to be the essence of planning. In other words, it is felt that a management plan for a working circle and especially the regulatory features thereof, plus the action program, should be built up into a summary from a number of prescriptions for individual areas readily identified on the ground. In the past we have frequently done just the opposite. We survey a whole working circle and come out with an inventory, stocking and growth data and a type or condition class map. Then we sit down in the office and write a plan. The results are often disappointing and lack utility. It is necessary, therefore, that we have a clear understanding of the kind and amount of data that are essential in the preparation of a good management plan. This is the foundation on which to build the plan. It must be strong enough to support the structure and thereby insure the confidence of those charged with the application of its prescriptions.

The foundation needed for the preparation of a management plan will vary with the conditions and circumstances pertaining to different working circles. The intensity of the use of the working circle as a source of timber and products governs to a considerable degree the intensity of management that may be practiced. The greater the diversification in the products to be harvested, the greater the variety of species, forest types and sites, and the larger the number of users of the forest, the more complicated becomes the plan of management. Accessibility, topography and the silvicultural system or systems being practiced are also important considerations.

Basic data needed and required accuracy will vary with the intensity of management. Expenditures for securing basic data should not be out of line

with the foreseeable benefits. Conditions change and timber grows. By and large, pressures for use of National Forest resources should increase and a trend toward intensification of management should be anticipated. This factor alone will probably justify larger investments in basic data for long-time production on the National Forests than might be required for immediate needs. With varying intensities of management in response to variable objectives and widely differing conditions over the country, this presentation can only point out the major needs and open the subject for discussion.

In enumerating or discussing the kinds of basic data needed for timber management plans, it is interesting to observe that each member of the committee independently and without prior knowledge of the other's thinking on this topic, placed the procurement of sound economic data first on his list.

We believe no sound planning can be undertaken until the planner has a comprehensive knowledge of the economic and social situation existing within the zone of influence of the resources in the working circle. Unless these resources contribute their utmost of benefit to people within that zone, planning loses its purpose. The planner need not be satisfied with the existing economic situation and he may see opportunities for practical benefit through introduction of new industries, new processes, new transportation, cooperative management, etc., and may take such needs into his evaluation of the problems and opportunities, but it seems like putting the cart before the horse to prescribe the detailed forest data needed or the degrees of accuracy under which it should be secured until he is reasonably sure as to how the results of timber fact finding should be used. For example, we should know considerable about the dependency of local people and the wood using industries. What is needed to achieve stable employment and a satisfactory standard of living? What are the species and products most in need and should be grown? What are the practical cuts per acre under varying conditions of topography and accessibility? What needs to be done to move less favored species or low quality trees? There are other factors but it is felt that the first requisite in planning is an appraisal of the economic and social picture, in other words, a rather searching problem analysis. From this the objectives of management can be charted indicating what and how much needs to be done to maintain and improve human welfare. Also, with such preliminary information, a more realistic guide is available as to what necessary additional data and practical limits of accuracy will be required to avoid over or under-refinement in methods to secure it.

Decisions based on the problem analysis must necessarily take into consideration the amount of money or manpower available for the job. In this respect, we must exercise good business judgment. In the long run, it is probably better to delay preparation of a plan until adequate reliable information and data can be obtained as the foundation, rather than accept inadequate and unreliable information and data, but it is recognized that pressing needs for formalized management will often require that plans be built from what is available or obtainable at low cost. Obviously, the final decision must be governed by local conditions and circumstances. From here on we turn to the forest property itself and list the items of information the forest manager will need as a foundation for a program of action to achieve the economic and social objectives, and at the same time maintain a highly productive property. These present themselves in the following order:

1. Facts pertaining to land area. Everything starts from the land and we need a classification. Since we are planning for the production of timber crops we should delineate the area of commercial forest land. The rest, by reason of quality, inaccessibility or other dominant use can be set aside. For the commercial forest area the most important element is its productivity, usually expressed as site. Where and how much is there of good, medium and poor? In the long run and irrespective of what is growing on the land at present, the highly productive area will respond to management with greater benefits per acre and per unit of effort, and therefore deserves greater attention from the planner along with higher accuracy in the fact finding.

2. Facts pertaining to timber cover. Superimposed on the land pattern of potential productivity and accessibility is the existing timber cover usually expressed by type and condition class. For present day management, we believe condition class is a more useful category than age, except where stands are definitely even-aged and management aims to maintain a series of age classes.

Type. Delineation of natural types is important since it determines to a considerable extent the kinds of timber which will be produced and made available in the economic picture. Major types need not be split down too finely into sub-types for regulatory purposes, but recognition of such sub-types are important in the application of silviculture. Type areas should be determined within accuracy of 10%.

Condition class. Within each type and for the working circle as a whole, we need to know the distribution of condition classes by area. The breakdown by classes will vary between regions and perhaps between forests. In the northeast we usually recognize six.

Sawtimber (Heavy - 5,000 b.f. per acre and up
(Light - 1,500 to 5,000 b.f. per acre

Pole timber (Heavy - 600 cu.ft. to 1,500 b.f. per acre
(Light - 10% stocked with trees over 5" d.b.h. to 600 cu.ft. per acre

Seedlings and Saplings - at least 10% stocked

Denuded - less than 10%

The areas of these categories and the volumes thereon form the major basis for regulation calculations and determination of allowable cut. Accuracy as to area determination should be within 10% and volume within 15-20%. Herein also we should have information as to health and growing condition. Are there any immediate salvage jobs, impending losses, etc. that require prompt attention? What intermediate operations are promptly necessary to prevent suppression or stagnation, etc? These factors will color the size and nature of the periodic cut and indicate which areas line up for early treatment.

Growth. For working circles predominately virgin timber, estimates of current growth or decline are useful mainly in determining which areas should be harvested first. A rough estimate of the volume growth that can be anticipated following the first cut is needed, however, so that the allowable

cut can be placed at a level which can be continued without serious interruption into the second and perhaps the third cutting cycles. Where large areas of cutover land are involved, a reliable estimate of current annual growth assumes importance. For areas deficient in growing stock, the cut should be substantially less than growth except for special salvage operations. Whether the cut is placed above or below current growth we need more reliable methods than are now available for estimating or measuring volume growth. Most data are based on fully stocked stands as the normal. Actual normality is usually at considerable variance with this. The planner is much in need of rapid and simple methods of measuring and predicting growth. In this field as well as in quality growth, spacing requirements, and expected yields under management, administration needs more help from research.

3. Facts pertaining to correlation with other uses. This information will undoubtedly be discussed in considerable detail under Topic 5. Where the uses are not conflicting, area segregation is often possible in the land classification mentioned in Item 1 above, with special prescriptions as to timber use for each. Elsewhere timber management may be materially influenced by the existence of local needs for domestic or industrial water supplies, outstanding aesthetic values or other influences. The facts of life pertaining to such demands need to be carefully determined for present and future requirements since they will filter into silviculture, transportation planning and operating methods.

4. Facts pertaining to protection. Under this category we should assemble all we know or can find out concerning pests. Appropriate references to published texts may suffice, but the current risks should be appraised. Protection against wind should be considered. The risks and hazards from fire should be briefed, and pertinent references to the fire plan are necessary.

In summary it is felt that building a management plan becomes merely an "intellectual exercise" unless the basic data available or to be secured can be interpreted into a program of action which will result in greatest benefit to local people. If so, a sound appraisal of the economic picture and the role which sustained production of forest crops can play in stabilizing the local economy becomes a first requisite.

A second is the conception that the land manager in his day-to-day job is confronted with the task of dealing with specific areas. Consequently, the action program which should be his current guide within the plan should indicate "what, when and how" within the several subdivisions of the working circle. Much of this can be more easily interpreted and applied if presented in simple graphic and tabular form with brief prescriptions for each, including:

1. Land area classification, by productivity and accessibility

2. Cover classification, by type and condition class, with area and volume for each.

3. Conflicting uses -- Municipal water, aesthetics

4. Special hazards - Over-maturity, pests, etc.

A third is the over-all factor of mean annual growth of the working circle. In the long run no program of sustained output can ignore the productive power of the soil and its expression in the stems which are standing on it. We need to know a lot more about this.

Topic Assignees:

D. W. Tabbutt - R-7

D. N. Matthews - R-1

March 15, 1949

G. S. Meagher - S. W. Station

S
PLANS—R 6
Timber Management

Portland, Oregon

March 17, 1949

## MANAGEMENT PLAN CONFERENCE - TOPIC 7

## STOP-GAP TIMBER MANAGEMENT PLANS

Dahl J. Kirkpatrick

During 40 years of administration prior to 1946, 23 management plans had been developed and approved at the Washington office level for the 92 working circles in Region 6. Accomplishment in completing the job of management planning seemed discouragingly slow; in fact, the project was about on a maintenance basis. Plans were becoming obsolete about as fast as new ones were being prepared.

That only 25% of our working circles had been covered with formalized management plans during these 40 years can be attributed to two principal reasons. The first is that in many of the working circles, plans were unnecessary. National forest timber was not being operated because it was not needed in the economy of the Region, or it was not accessible and could not feasibly be managed in competition with the liquidation of extensive private timber holdings of better quality in the more accessible zones. The second important reason for a lack of progress was that there appeared to be a feeling of frustration on the part of our resource managers charged with the responsibility of preparing management plans. It looked as if in the minds of our timber administrators the management planning job had been built up as a technical, complicated project which was entirely beyond their capabilities.

Timber supply problems in Region 6 grew particularly acute during the war. War demands for forest products coincided with the exhaustion of readily available private timber resources within and adjacent to a good many of our working circles. The consequence was that interest in the national forest resource grew by leaps and bounds and it became very evident that working circles for which plans previously had been of little more than academic importance were becoming economically and practically operable. The need for early and decisive action seemed clearly evident.

To overcome the attitude of incompetence which was widespread among our timber management field force, the idea of developing a simple, very rudimentary type of management plan was conceived. On July 15, 1946, Regional Forester Andrews wrote to the supervisors and transmitted a copy of an outline for what we have referred to in the Region as a "streamlined" management plan. He informed them that in two years he would expect each forest to submit a streamlined plan for each active working circle not covered by an accepted management plan. In the two-year period that ensued, with a very nominal amount of assistance or urging from the Regional Office, the job was completed.

It should be stated at this point that Region Six has gone as far as it seems possible to go in delegating resource management authority to the District Ranger force. In consequence, the streamlined management plans are almost 100% the product of ranger effort. It must be understood also that in Region Six we have the advantage of fairly adequate resource data from the Forest Survey.

Now a word as to the nature these stop-gap management plans. Here is the outline:

"TIMBER DISPOSAL PROGRAM FOR THE NATIONAL FOREST RESOURCES

OF THE ____________ WORKING CIRCLE

"I. Introductory statement followed by a brief summary of the recent history of cutting on National Forest lands within the working circle and present and prospective industrial dependency upon the public timber.

"II. A statement of any specific management objectives (exchange, co-op unit possibilities, etc.) which may be peculiar to the working circle in question.

"III. An analysis of National Forest resources within the unit giving the clearest possible picture of the areas and timber volumes subject to management. As a minimum this analysis should include:

"A. A Forest Survey type map of a scale of 1" to the mile showing, (1) the Working Circle boundary, (2) block boundaries, if significant, (3) Forest types on all National Forest lands within the circle, and (4) ownership of alienated lands within the National Forest boundary by principal owners

"B. An overlay for the above map indicating in distinctive legend, (1) National Forest lands not available for cutting because of currently recognized limited areas or formally dedicated reservations such as natural areas, wilderness areas, etc., if any, (not campgrounds, road or streamside strips, and sundry informal reservations), and (2) any National Forest lands within the available zone of the working circle considered to be inoperable during the first cutting cycle because of inaccessibility, non-commercial timber, extreme topography, etc.

"C. Summary tables showing lump sum acreage figures for the dedicated reservations and areas by Forest Survey types of (1) the limited areas within the non-available zone of the working circle, and of (2) the available portion of the circle with a segregation of operable and non-operable areas. The gross operable available area should be appropriately discounted for (a) unmapped reservation areas such as streamsides, roadsides, campgrounds, etc., (b) untyped areas of inoperability, or (c) other specified reductions needed for reasons peculiar to the unit in question.

"D. Summary tables showing lump sum volumes for the dedicated reservations and volumes by species within (1) the limited area of the non-available zone and within (2) the available portion of the working circle, segregated by operable and non-operable classes. The available operable volumes should be appropriately discounted for unmapped reservations and for untyped areas of non-operability or for other reasons as indicated in C above.

"This section of the plan is vitally important since the value of the entire project hinges upon the sound and realistic treatment of the basic area and volume statistics. In evaluating these data it must be remembered that the permissible rate of cutting will be predicated upon future as well as current operating potentialities of the circle. A clear showing of the source of data employed in the development of the figures and the extent and nature of any discounts or adjustments which may be made in arriving at the net available operable areas and volumes is also essential. To assure that the latter will consistently be done, and to provide a uniform method for the assembly of the information, forms similar to the attached samples should be used.

" IV. Calculation of the allowable annual cut by the methods outlined in the Management Plans Section of the Timber Management Handbook with a clear showing of the premises upon which the calculations are based.

"V. A brief statement of the sale program that will be followed during the next five years in the management of the working circle, indicating planned size of sales, their general location, the period for which they will run, the limitations of cut that will be imposed, etc. This statement should be supported by a one-half inch administrative map showing (1) the approximate boundaries of the proposed sale units, (2) the existing transportation system, and (3) the transportation developments that will be required to instrument the five-year sale program.

"VI. A five-year cutting budget tabulating the sale units and volumes it is anticipated will be cut from them by years. The sale areas listed in the tabulation, for clarity, should be keyed to the map required in Item V above. (See sample cutting budget form attached.) "

In addition to the outline, we provided the form of tables to be used for summarizing volume and type area data so as to secure uniformity in the presentation of these statistics and so as to permit their summation on a regional, state, and forest basis.

In looking back at the project from a regional standpoint, we feel that the effort has been extremely worthwhile. In the first place, it has done something to destroy the bugaboo that management planning is a job that is beyond the capabilities of the District Ranger force. It has provided us with a better on-the-ground current analysis of the state of the manageable resource than we ever had before. It has yielded a cutting budget, working circle by working circle, which will be good for five years or so.

Because these plans are sketchy and do not conform to the standards which are currently in vogue for the development of working circle plans, we have not submitted them to the Washington Office for approval, but have approved them rather at the Regional Office level as interim programs until planning on an acceptable standard for submission to Washington can be achieved. We hope that we have laid here the foundation of planning by field men which we will be able to carry forward at the field level - that our streamlined plans, rough as they may be now, will mature into management plans which will be real live working tools for the folks on the ground. After all, it is they who will accomplish whatever management the national forest resource receives.

Topic 7 - Stop-gap Timber Management Plans, Region 8

A. J. Streinz

In 1938 stop-gap timber management plans, then called "Policy Statements," were prepared for most of the working circles in Region 8 for which management plans were not in preparation or not covered by plans approved by the Chief. At the time, it was thought that such plans were soon to be superseded by plans or policy statements prepared on a more adequate basis and intended for the Chief's approval. The plans were to be in effect for a maximum period of three years. The plans were approved by the Regional Forester. The following outline was used as a guide in preparing the plan.

1. Location

   County or counties in which unit is located. Statement as to whether in Piedmont, Upper, Middle, Lower Coastal Plain, or other physiographic region.

2. Area

   Gross area
   Net National Forest area
   Private land
   Condensation of acquisition Form 706 for unit when such data are available.

3. Economic Factors

   a. Population

      (1) Inside circle, suitability for employment, employment needs of inside population.

      (2) Adjacent to circle within five miles-data as above.

      Note: Best estimates available - no census to be made.

   b. Markets

      (1) Tabulate as follows:

| No. | Type of Plant | Name of Plant | Annual consumption | Volume to be supplied by N.F. |
|---|---|---|---|---|

      (2) Show on map #1 accompanied by legend using standard symbols, location of all wood or forest product using and consuming plants, indicating each plant by a number corresponding to the tabulation in the report.

      Note: No field census to be undertaken. Job to be done by estimates of forest personnel.

c. Transportation

(1) Brief paragraph explaining transportation conditions.

(2) Show on map #1 all roads, whether State, County, or Forest Service, truck trails, motorways or travelable fire breaks, surfaced or unsurfaced, using standard legend and putting legend on map.

<u>Note</u>: No fancy drafting desired - use crayons.

4. <u>Protection Problem</u>

a. Fire

(1) A table showing fires by classes and causes for five years if data are available.

(2) A table showing National Forest area burned by years and months for as many of past five years for which data available.

b. One paragraph on grazing, stating cattle, hog, sheep and goat problems.

c. One paragraph on all insects and fungi.

d. One brief paragraph on timber trespass.

5. <u>The Stand</u>

a. Best available estimates on all purchase units purchased since 1933; use acquisition data which are being supplied you. On other units, use management data if available. On the occasional unit where no data are available, you will have to do your best estimating, using acquisition or any other available data as a base.

b. Insofar as possible, list your estimate by species and products and insofar as possible, make a division between operable and inoperable stands. Separate green timber from dead timber estimates, such as chestnut, tarwood, stumpwood, etc.

6. <u>Growth and Yield</u>

Use available data as follows:

a. Where management data for circle are available, employ these.

b. Where acquisition has made studies such as on the Burt Estate, Talladega, employ these data.

c. Where data are available from the management plans of comparable working circles on the forest, employ these, making adjustments to fit your needs.

d. Where no data are available, employ Van Mantel's formula as a means of regulating the cut:

i.e., $$\frac{V}{1/2\ R}$$

V = Total volume of growing stock.

R = Rotation age.

For units where no data are available, use 100 years as rotation age.

7. Timber Sale Policy

a. Statement of policy as to amount of timber to be sold, justifying any departure from indicated or computed cut.

b. Size and type of sales to be made.

c. Class of markets and operators to be aided or supported.

d. Utilization requirements.

e. Brush disposal.

8. Marking Principles

One short paragraph for each timber type in budget. Abstract of marking rules for that type.

9. Cutting Budget

a. List units and approximate volumes to be cut in next three years. At least 60% of three-year cut is to be budgeted; 90% of F.Y. 1939 cut to be budgeted.

10. Appendix

Must contain map #1 as instructed, and map #2 which will show cutting budget and information as to location of merchantable areas, non-timbered areas, plantations, etc.

All applicable marking rules will also be included in Appendix.

Any data available as to stands, volumes, growth, etc., should be in Appendix - Summaries only to be in plan.

Plan should be held to three or four pages, exclusive of Appendix and Summary page.

11. Summary

First page of this report will be summary.

Note: Summary must not extend over one page (See attached sheet).

Three months were allowed for the preparation for the plans. In most cases the plans were prepared and written by the Supervisor's Timber Management Assistant. The primary purpose of the plans was to initiate a definite action plan for timber management on the units involved. The plans produced were satisfactory for this purpose. Many of these plans are s till in use with revisions in the cutting budget and allowable cut.

Our current conception of a stop-gap plan is one which is based on available data and information without an up-to-date forest inventory. A brief study is usually made of the area cutover 5 to 10 years ago in Forest Service sales to check the cutting cycle. The scope and form of presentation is the same as for a plan with an up-to-date forest inventory. The period covered is at least 5 years and preferably 10 years. The plans are prepared and written for submission to the Chief for approval. The purposes of the plans are: (1) to organize and record the existing information and (2) to develop a plan of action for the next 5 to 10 years.

______________________________

______________________________

______________________________
(Case designation)

Summary Sheet

Name ________________________________________________

Area ________________________________________________

Volume: Green and dead separately by products but not by species.

Growth: Yield and/or regulation.

Cut: Annual - Three year period.

Percentage to Cut: ____________________________

Cutting Cycle ____________________________

Prepared by ______________________________
Name and title

____________________
Date

Approved by ______________________________
Supervisor

____________________
Date

Approved by ______________________________
Regional Forester

____________________
Date

MANAGEMENT PLAN CONFERENCE
Hot Springs National Park, Arkansas
March 28 to April 8, 1949

# TOPIC 8 - TRANSPORTATION PLANNING FOR MANAGEMENT PLANS

Donald N. Matthews

To get this subject before us in its proper perspective, let's look at two working circles. One is a working working circle and the other is an undeveloped working circle.

The working working circle operates under the multiple use principle. Every acre is productive. And the production of every acre is used. Productive capacity is harnessed to produce wood products to satisfy human wants. The working working circle produces a steady flow of logs, poles, posts, shakes, shingles, piling, pulpwood, fuel wood, Christmas trees, and minor forest products according to its capabilities. At one and the same time that it produces wood it is also a good watershed, a good playground and a good home for fish, game and domestic stock. It also gives steady employment and adds stability to the community. In such a working circle every acre has its role to play in producing the greatest good for the greatest number in the long run. If the greatest good is in sheep, it produces sheep. Some acres have more than one talent and they may produce wood, recreation, venison and mutton, and at the same time do their share as a good watershed. In short, all of the capacities of the working working circle are harnessed and harmonized to produce the greatest benefit to the greatest number of people for a long time.

It will not take many words to describe an undeveloped working circle. Such working circles are unmanaged and low in production. Their condition and their production of wood, water, forage, and recreation are largely the accident of natural forces. Draw a line around a forest area that has intrinsic future possibilities as a working working circle and you have a typical undeveloped working circle. The undeveloped working circle is in the pioneer stage. Its management, if any, is extensive, consisting principally of fire protection and its contributions to society are those of the pioneer. The working working circle is a product of civilization and essential to its continued growth and development.

Management is the feature, of course, that distinguishes the working working circle from the undeveloped working circle. Management is composed of many parts harmonized into a productive combination. However, the one phase of management that stands out as being absolutely essential in transforming an undeveloped working circle into a working working circle is transportation. In simplest terms, transportation is the connecting link or chain between the products of the working circle and the consumer. In working working circles this connection is strong and effective. In undeveloped working circles it is the missing link. The management plan is the instrument we use to build a transportation system that will put the working circle to work efficiently.

In this country the consumers of forest products tend to be many hundreds or even a thousand miles or more from the tree. Nevertheless, the long distance transportation of forest products from mill to consumer is not within the scope of this paper. The discussion that follows is concerned with transportation from the tree to a mill, market, or use in or near the working circle.

We can pass lightly over the transportation of forest products by water because it is of minor importance at the present time. This is a one-purpose mode of transportation that does not contribute very much to the complete development of all the resources of a working circle. Transportation by air may be with us in time but it is of no immediate concern. Railroads are of diminishing importance as prime movers of forest products. The forest manager has few regrets in the passing of the logging railroad. This was also an inflexible, single purpose, pioneer mode of transportation. It was effective in the mass movement of wood but it did not help very much in developing all the resources of a working circle! The transportation dollar that went into a logging railroad bought a connecting bond of steel to outside markets, but it was a temporary link. Once the steel was removed the forest tended to be just as remote and inaccessible as ever. Roads had to be built to carry on the day to day utilization, protection and management of the forest. The logging railroads drained away important transportation dollars found only in high-quality virgin timber and left little permanent good. They exerted strong pressure for overcutting, clear cutting and poor utilization. Although there will probably be some rail transportation within our working circles as long as there are railroads, from now on railroads will function as part of a transportation system that is planned to facilitate complete development of all the resources of a working circle in ways that will promote the stability of local dependent communities. However, even though we will talk exclusively in terms of roads, many of the principles developed will apply to transportation by water or railroad. Some of the principles might apply to transport by air, but some might not.

When a working working circle is fully productive, it requires a road within skidding distance of every tree to be harvested. "To be harvested" was added because in mountainous working circles, even under the most intensive management imaginable, there may be large areas of trees that will not be cut and utilized. Because of the steep topography and poor site quality in some of our western working circles, production of wood for use off the stump may be confined to less than 50 percent of the gross area of the circle. The remainder of the area will be managed for water, grazing, wildlife or recreation. Some of the area may be so barren and rough that it will not be managed at all.

There is also a time element. It is not necessary to have a road within skidding distance of every tree to be harvested except at the time the tree is to be cut. In some cases this may mean that a road will be needed only once each cutting cycle or rotation. However, in many cases, the primary need for a road to harvest the tree at the end of the cutting cycle or rotation may be supplemented and reinforced by needs for transportation to care for the tree from the seed to the sawlog. Recreation, grazing and watershed management also require roads. A permanent road system will be required to meet these recurrent needs.

From what has been said so far, it should be apparent that transportation is a primary consideration in laying out a working circle. In fact, it would be easy to get into a which is first, the hen or the egg, sort of discussion. Efficiency of transportation from tree to market should be the ruling factor that determines the boundaries of a working circle. So long as we move wood on roads, it will be cheaper to go downhill than to go uphill. (Let's ignore the exceptions to this generalization.) That is the basic reason why working circles so often coincide with drainages and why road systems resemble drainage systems. Main roads correspond to rivers, branch roads correspond to tributary creeks and spur roads correspond to the last spring branches of the drainage system. We would do a lot of thinking

before we would design a drainage system in such a way that the water would have to be pumped uphill far, far into the future. We should do a lot of thinking before we defy gravity and lay out a working circle that will require the movement of wood uphill far into the distant future. To do it in the name of community support may, in the long run, work to the detriment of the community. We already know something about the cost of defying the law of gravity. We do not want to learn the hard way what it can cost to defy economic laws. The working circle and its transportation system should be designed to obtain efficient - and that means low cost - movement of wood from the tree to market.

In addition to the transportation of wood there may be, and usually is, need for roads to penetrate the nonproductive forest lands in the working circle to facilitate the protection of the timber cover and to facilitate the multiple use development of the circle.

Multiple purpose roads work to the advantage of the timber. The other uses carry part of the cost and to that extent cause a reduction in the cost of hauling the timber. Other uses not only share the cost but a combination of two or more uses may justify a higher road standard than timber alone and result in a reduction in the cost of hauling timber. Therefore, important advantages accrue to timber from the development of multiple purpose roads.

Some of the complexities of transportation planning for timber management plans begin to be apparent.

A road system for an entire working circle is not constructed in a short space of time or as one job. (How we would like to try that sometime!) In most all cases we are harvesting our working circles for the first time. When the cutting cycle or the rotation is completed, a road will have been built to within skidding distance of every tree. In most cases we are in the early stages of this development. We tend at this stage to plan roads piece by piece to reach this or that stand of timber that is ripe for the harvest. Getting a road to every tree seems to be something that we will not need to worry about for a long time.

Nevertheless, here is a major challenge to our ability to operate in a planwise fashion. If we leave the production of a road system to accident, the results will be unsatisfactory. Building a succession of roads to individual stands one after the other will not automatically produce an efficient road system in a working circle. The efficient road system will be the product of a plan. The road built in 1949 must mesh in with roads to be built in 1959, 1969, and so on down through the years until the entire working circle has been developed with a transportation system. This objective of developing an efficient transportation system for the entire working circle should be before us from the beginning and all the time. Furthermore, the objective is not just to produce an efficient system to move wood. Multiple use development of all the resources in the working circle is the objective of the transportation system.

Now, let's bring road building into focus in terms of miles and dollars. The February Timberman reported that during 1948 Oregon and Washington loggers spent $24,000,000 to build about 2,400 miles of new road, or an average cost of $10,000 per mile. However, some roads cost them as much as $30,000 per mile. These roads were reported to have opened up 806 square miles of timber with an average of 3 miles of main and feeder roads per square mile. This is about $30,000 per section of 640 acres, or almost $50 per acre. On a regional annual cut of 8 billion this indicates an average road

construction cost of about $3 per thousand board feet. The same article states that Oregon and Washington loggers have built some 36,000 miles of roads at a cost of $350,000,000 since they made them their principal means of transportation. One of the most significant features of this development has been the trend to higher road standards.

In Region One we believe that our road building chances average as tough as anywhere else in the United States and we have much lighter stands than our neighbors on the West Coast. It cost us from $4 to $8 per thousand board feet to construct roads to move our logs from the woods to mill or railroad. Every time we sell a million board feet we need to put from $4,000 to $8,000 into the construction of roads. We do not mention these costs to boast about them. They are mentioned to show the magnitude of the costs involved in developing a transportation system for a working circle. Other regions may be fortunate in having lower costs; nevertheless, the cost of the transportation system is an important consideration in all regions.

While we are on the subject of transportation cost it may be well to point out some of the relations between these costs and the plans and policies for the management of timber. For example, a policy of light cutting tends to increase the amount of road that must be built per year to harvest each thousand board feet. The total cost of the road system for the working circle may be affected very little but rate of expenditure is increased materially by a policy of light partial cut. Shortening the cutting cycle has the same effect. Nevertheless, every forester dreams of the day when all of his working circle will be opened up so he can salvage mortality, make thinnings, and really manage every acre for highest production. Intensive management of the entire working circle requires a complete transportation system. Therefore, anything that tends to accelerate the completion of the system works in favor of intensive management, increased production, and multiple use.

Although a transportation plan is a vital part of a timber management plan this does not mean that every last detailed road and bridge specification should be included in such plans. The management plan sets up broad objectives, coordinates uses and directs action. The first concern in a management plan should be to see that the area concerned can be developed by a transportation system into an efficient working working circle. Another important function of the plan is to provide for the orderly year by year development of a road system. This development must not be left to accident. First, there must be a clear concept of the complete road system, and then, each section of main, branch and feeder roads planned to fit into the system. In order to accomplish these objectives it will be necessary to have complete understanding of engineering phases of road building and the help of logging engineers and road engineers. Indeed, it may be necessary to make some detailed road plans with every standard and specification worked out to the last yard of dirt. These may be essential to the fulfillment of the timber management plan, but they are a supplement rather than a part of the plan. Such detailed engineering plans should be referred to in the timber management plan or included in the appendix.

Nevertheless, every management plan will contain considerable discussion of transportation. Emphasis will be on the development of a transportation system rather than upon details of construction or operation. In most cases it will be desirable to include a transportation map showing at least the present and planned main roads. The plan may include a list of the

principal roads in the system and list the roads to be built in the first 5 or 10 years. For all of these roads it will specify the service standards, covering such items as:

1. Kind of use - single purpose or multiple purpose.
2. Duration of use - permanent, first cut, 5 years, etc.
3. Season of use - yearlong, summer only, etc.
4. Tonnage to be moved by kind (logs, ore, cars, trucks, etc.), size (length of logs, etc.), rate (length of hauling season, loads per day, etc.), etc.

From these service standards the logging engineers and the road engineers will develop the road and bridge construction standards and the specifications of the equipment best suited to haul the products of the working circle over the roads. Detailed construction standards and equipment specifications do not belong in the body of the management plan. (Special construction standards or equipment specifications may belong in the plan or its appendix if they need some explanation or justification.) These details belong in transportation plans or in logging plans.

In case anyone sees in the above any hint of discrimination against engineering plans it can be pointed out that detailed logging plans, planting plans, fire plans, protection plans, etc., do not belong in a management plan. All such plans are concerned with the technical details of individual jobs. They go to work after the timber management plan has set the course and given the direction. In this concept the management plan is the plan of plans. It plans the transportation system but it does not build it.

When the timber management planner passes his service standards over to the logging and road engineers, he can point out that in most cases, where mining is not a major factor, the big hauling job on the national forests in terms of gross tonnage is timber. Timber is the dominant heavy hauling job on most single purpose or multiple purpose roads. Therefore, if roads are constructed to standards that will take care of the timber moving job, they will adequately handle the loads imposed by other uses. Amount of traffic may affect alignment and road width, but the road that is designed to carry the timber loads should be adequate to carry the weight of all other hauling. Mining use may be an exception, of course.

Experience to date proves that over and over again we have set our standards too low. The dust from one construction job has hardly settled before we see the need for a better road. The way to avoid this is to get our sights set high enough in the first place.

There is another subject that deserves mention in this paper. That is the permanency of roads. It appears that there will be permanent roads, periodically used roads, and temporary roads needed in the long-term development of working circles. Permanent roads will be "put on" the transportation plan and presumably they will be adequately cared for. Roads that are built for a short period of use and then "put to bed" or abandoned altogether require careful consideration. Our experience is probably too short to be a very reliable guide. Perhaps we tend to assume too readily that roads can be put to bed or abandoned. We talk glibly about multiple use with one breath and then use the next to say we will close roads to use. If we ever get a complete picture of a real working working circle, we may see much to our surprise and amazement that practically all the roads that were ever built are being used day to day, or periodically by short periods or periodically by long periods.

It is time that we provided wisely in our management plans for the future disposition of every last mile of the road system. The time to take the first step is when the service standards are drawn up for the engineers. This early decision is necessary in order that permanency of use can be adequately provided for in locating and constructing the road. Principles, policies, desirable practices and objectives belong in the management plan; engineering details do not. We do not want to allow administrative procedures to become so rigid that they will prevent us from spending maintenance money on roads after they are put to bed, if that is necessary to preserve the road. Most of all we need to keep constantly before us a picture of the varied activities dependent upon the transportation system in a working working circle.

3982

## TOPIC 8 - TRANSPORTATION PLANNING FOR MANAGEMENT PLANS

Comments by A. P. Dean, Chief, Division of Engineering
February 7, 1949

All-purpose transportation plans are incomplete in many regions, partly due to changing concepts in timber management practices and sometimes to insufficient participation in planning by Timber Management divisions. While reasonably dependable as a guide for main-haul roads, some all-purpose plans appear to fall far short of providing for the expanded system of secondary branch or lateral roads considered necessary for proper management of timber crops. Timber management planners should therefore be sure that all-purpose transportation plans have been kept currently revised before depending on them too much. Even then it will pay to make sure that the plan fits the latest conception of timber management. The network of main-haul roads and laterals, at least, and spurs that will remain on the system permanently, should be planned and coordinated concurrently with the development of the operating plan for each working circle.

It would appear essential to develop comprehensive, though not necessarily final, operating plans in conjunction with every timber management plan. Only in this way will it be possible to develop the road plan. To the extent that the operating plan affects the road system, it should be crystallized and refined enough to tie down the routing and standard of main-haul roads and laterals.

Operating and transportation plans should be carried to the point where the planner can indicate the permanency, season of use, grade, curvature, probable traffic intensity and maximum bridge loading on roads required by the logging operations. The timber management planner should not attempt to stipulate grade, curvature or bridge loadings but he should give the engineer the type of trucks, GVW ratings, wheel loadings, length of logs, maximum speed and maximum rate per month of cutting or the maximum number of truck loads per average day that will use the road. From this data, the engineer will determine desirable grade, alignment and roadbed or bridge standards.

I believe every timber management plan should contain a map showing the planned routing and service requirements or construction standards of all main-haul and branch roads plus any spurs which will be continued in existence after the initial cut. In rough country, the general pattern of all spurs should be indicated.

Many of the following planning functions might be performed by either the timber management planner or an assisting engineer. No attempt is being made to indicate who should do what but the transportation planning done in conjunction with timber management planning should include:

1. Laying down the road system that will allow the most efficient logging operation aside from the question of existing roads.

2. Laying down the existing system of roads serving the national forest lands to be logged and connecting that road network with regularly maintained permanent roads leading to markets, primary or interstate transportation facilities.

   Particular care should be taken to ascertain the planned permanent location or routing of interstate, state primary and secondary and dependably maintained primary county roads. Many of these will be rerouted within the next decade. As a rule, the relocations are reasonably well fixed. The information can usually be obtained with a little investigation.

3. Adjusting the most desirable road plan from a timber management standpoint (see 1) to roads on the existing system and planned Federal aid, state or county relocations which are, or will be, of reasonably adequate standard and dependably maintained.

   The planner should not, of course, be frozen to this adjustment but thorough consideration, including a careful economic analysis, will be worthwhile before planning a Forest Service or timber road destined to reach the same ultimate market or distribution point as an existing public road or one planned for early construction, assuming standards of latter will be reasonably adequate.

   There should, of course, be no hesitancy about proposing a new road if economic or other advantages are positive and obvious. Realistic maintenance, as well as construction costs, should be used however in appraising the advantages or comparative benefits of building special roads.

4. Conceiving all roads at all likely to remain on the forest transportation system as part of the permanent operating plant; not as project facilities for the initial sale.

5. Working out the construction standards and average cost of construction and maintenance for each road on the transportation plan for the timber management plan under preparation. This is, of course, elementary since no logical comparison of logging methods is possible without transportation costs of which one component will be road cost. Road cost being the cost of the road or that part chargeable to timber amortized over the amount to be hauled plus average annual maintenance per M per year. At least 80% and preferably all of the construction cost chargeable to timber should be amortized over the first rotation cut. Maintenance estimates should include the amount necessary to keep the road in existence during periods of nonuse by timber where other uses of the road do not require or cannot support interim maintenance of proper quality to maintain the standard required for timber use.

It is desirable to make these estimates a matter of record no matter how they will be financed so that there may ultimately be some correlation between timber management plans and projected estimates of maintenance requirements. There is no correlation at all at the moment.

Both construction and maintenance costs can be determined with reasonable accuracy from tables or charts prepared for the purpose if the tables or charts are carefully compiled. These should ordinarily be requested by Engineering. In the preparation of these, the first step should be for the timber management planners to set up road classes that encompass the combinations of service standards most often encountered in the region, subregion or forest. Service standards are:

1. Duration of use, permanent, first cut, 5 year, etc.
2. Season of use, yearlong, dry season only, etc.
3. Maximum gross vehicle weight.
4. Maximum axle loading.
5. Maximum wheel loading.
6. Width of bunks.
7. Length of logs.
8. One-way or two-way log haul.
9. One-way log haul and return for empties only.
   a. Controlled or uncontrolled passing.
10. One-way haul and two-way general traffic.
11. Average maximum speed - a. Loaded
    b. Empty
    c. Other traffic
12. Loads per day, each way.
13. Days per week of log haul.

Next the engineer should take over in converting the service standards to construction standards for each class; and sub-classes as necessary.

Again the engineer should develop cost estimates for each class under as many sets of conditions as soil, topography, clean-up, etc., as may be necessary to meet average representative conditions.

Then the timber management planner and the engineer should work together to modify service and construction standards as required to meet cost criteria. Never tamper with costs or construction standards without considering the effect on service standards. The only safe way is to start by revising service standards and then follow through by revising construction standards accordingly before attempting to re-estimate costs.

Tie all cost estimates down by dating prices and preferably indicating average of net skilled and common labor rates on which prices used in estimate are based. Equipment rental and materials prices are reasonably easy to trace if date of estimate is known, and therefore do not need to be recorded.

Net labor rate is actual cost per productive man-hour; annual straight time rate divided by 1,760 hours where leave is allowed. If custom at time of estimate requires transporting labor on Government time, that should be accounted for in net rate. If average cook house loss is $1.00 per man-day, that should be recognized in net rate.

Estimates serving as basis for charts, tables and transportation planning should be based on estimators best judgment of cost at current prices and rates. Estimate should be built up by expense components for which price is known not obtained from adjusted comparisons with jobs consisting of several dissimilar work items.

Adjustment of estimates for future trends or foreseeable changes in prices or conditions should not be made in base tables. Estimators should never be urged or instructed to lower estimates. If the estimate is higher than can be afforded then it is the administrator's job to revise the standards and have the job re-estimated or to arbitrarily reduce percentage wise on the basis of savings the administrator believes possible through better management. Estimators cannot be held responsible for estimated costs arrived at by directed distorting of pricing. The administrator is sometimes justified in revising estimates but he, not the estimator, should be held accountable for his guesses or reductions in quality due to inadequate allotments.

Classifications for estimating purposes should not be too broad. Cost estimates for grading should for example be related to side slopes, kind of material and average yards per mile. The road mile alone is too broad a base for flat and hill country alike. Bridge and roadbed costs may vary considerably with GVW, axle spacing, wheel loads and roadbed materials. These and speeds will likewise materially affect initial and replacement costs for surfacing and road topping.

Where trends indicate currently excessive road costs may come down, it may be good business to locate for ultimate construction on the desirable standard and allow initial construction, properly engineered, of course, to be done on a lower location standard if that will reflect a material saving. For example, initial construction may be permitted to take the road further up canyons out on points or up over points than the ultimate location in order to avoid fills or heavy cuts. In such an event the grade would be held down so as to fit the ultimate alignment. Turn-outs may be substituted for double tracking. O.K. to build a temporarily substandard road within the limits of a permanent and standard location but don't plan or build a permanent road on a temporary location.

Bridges should always be estimated and considered separately.

The expense items included in road costs should be clearly identified. Total cost is usually close to 50% more than contract prices and field or on-site expense.

Road cost estimates used in developing timber management plans should be total costs, whether estimate is for maintenance or construction. The time to sharpen the pencil and when savings can be made is in programming, arranging and managing construction, never in owner estimates.

Road cost estimates used in timber management plans should include total cost of standard required by logging for roads which may serve other purposes but won't be built for those purposes before being needed for timber.

Maximum advantage should be taken on the other hand of roads being built for other purposes and on which standards can be increased without much expense to those required for logging.

Don't overlook surfacing or topping in construction or maintenance estimates. Some sort of surface treatment involving importation of material will be required on 9 out of 10 roads to be used by heavy trucking.

Light ($1\frac{1}{2}$- to 3-ton) trucks may be harder on roads than much heavier trucks if loading on axles or wheels is excessive or trucks travel at high speed on curves on dry roads during days of low humidity.

Most operator cost reports should be doubled before being used as estimating guides for Forest Service financed work. Operator cost is most likely to resemble contractor price less carrying charges, insurance, etc., and sometimes equipment depreciation absorbed in logging costs. Operator often figures on finishing a job as part of second year maintenance operations.

Beware of using regional averages when it comes time to estimate the cost of particular job. In most regions these can be off 50% or 60% or even 100% for a particular job and accurate within 5% or 10% for the average job in the region.

The Engineering News construction cost index is the best guide in revising carefully made cost estimates of known date if no regional price index is available.

A few well-signed sample road sections are helpful in assisting both engineers and timber management planners to visualize location and construction standards. About 3 miles or more should be marked at each beginning and end of curve and break in grade with signs facing each direction and giving in easily readable figures grade, radius of curve, length of curve, width of road. Available information on side slope, yards per mile, cost of construction, rate of loss of road metal or surfacing, cost of replacement and cost of maintenance helps still more.

The best feel of these sample road sections is obtained by riding over the road in the type of truck for which designed (loaded with logs) or driving a long-body, well-loaded stake side over the road.

March 17, 1949

# TRANSPORTATION PLANNING*
# and
# TIMBER MANAGEMENT PLANNING

C. Otto Lindh - R-3

## A. Recommended Terminology

### 1. Timber Harvesting Roads

The terms "access" and "utilization" roads are not wholly appropriate. It is recommended that those roads within or to serve commercial forest lands and being used or to be used primarily for transporting timber products be called "timber harvesting roads" when it is necessary to use a "name".

### 2. Timber Harvesting Road Classes

(a) Main timber harvesting roads are the permanent medium or high standard trunk roads that connect the larger blocks of timber in a working circle with the manufacturing plants, log dumps and/or public highways or railroads.

(b) Branch timber harvesting roads are the permanent low or medium standard secondary roads that connect the medium-size blocks of timber in a working circle with the main roads (or highways or railroads).

(c) Spur timber harvesting roads are the temporary low standard roads, used for a few days each harvest or intermediate cut, that connect the smallest blocks, compartments or logging units of timber with the permanent, main or branch timber harvesting roads.

## B. Transportation Plans for Working Circles

An up-to-date and currently maintained transportation plan should be available for each working circle. It should be the product of the joint planning efforts of a timber management planner and an engineer. Without going into details it should consist of:

1. A large scale map showing the location of existing and the general location of all proposed highways, railroads, and main or branch timber harvesting roads that serve or will be needed to serve the harvesting of products from the working circle. Each class of transportation artery to be shown on the map by distinctive colors or symbols. In addition, the service standard of permanent timber harvesting roads (such as one or two-lane main) will be distinctively shown on the map. Temporary spur roads will not be shown on the map. Any field work, such as the location of control points or feasible routes for proposed roads, will have to be done in advance of preparing the map and plan.

*Supplement to Topic 8, Transportation Planning for Management Plans

2. A tabulation which will show for each main or branch timber harvesting road such appropriate information as - construction cost (in whole or by sections), class, design, specifications, year proposed roads needed, period and duration of use each year and cutting cycle, volume and type of business and maintenance program and cost.

Basic to the preparation of the map and tabulation such information as location of manufacturing plants or log dumps, timber data, timber management objectives, other uses than timber harvesting, transportation costs by the different class and design of roads and trucks, and costs for road construction and maintenance will be needed in order to develop the best possible plan. Items such as who will locate, prepare detailed designs, who will construct or maintain, who will supervise construction, etc. are or should be established on a Regional basis and need not be repeated in each plan.

Each transportation plan for a working circle must be currently maintained; as a minimum it should be thoroughly revised periodically each time the timber management plan is revised.

C. Transportation Data to Include in Timber Management Plans

1. If an up-to-date transportation plan is available for the working circle.

In this case a brief reference will be made in the timber management plan to the transportation plan. No other action is necessary or desirable.

2. If there is no up-to-date transportation plan for the working circle (none in Region 3).

In this case the timber management plan should provide for the following pending the completion of a separate acceptable transportation plan:

(a) A map showing the existing and proposed transporta- arteries including main and branch timber harvesting roads by appropriate colors or symbols.

(b) A concise tabulation for proposed main or branch timber harvesting roads (construction or betterment) about as follows:

| Map No. | Class | Type of Work in Miles | | | Estimated Cost for Work | | | | Year |
|---|---|---|---|---|---|---|---|---|---|
| | | Const. | Bett. | Surfacing | Const. | Bett. | Surfacing | Total | Needed |

No additional data are needed in the timber management plan; at least in Region 3 where we have established Regional standards for permanent timber harvesting road classes, design, location, construction and maintenance and for the location, construction and "putting-to-bed" of spur roads.

Forest Service

R
SUPERVISION
Meetings

March 30, 1949

# TOPIC 9 - APPLYING SILVICULTURE TO MANAGEMENT PLANNING

L. I. Barrett, Chief,
Division of Forest Management Research

In discussing this topic, I think that considerable misunderstanding and confusion can be eliminated if first we clarify the meanings of a few terms which are important in the language of management planning. These terms are silviculture, regulation, and management. The interchangeable use of silviculture and management or management and regulation creates about the same mutual understanding as does use of the term "selective cutting." I continually find myself engaged in lively arguments on one or the other of these only to find out eventually that the parties involved are heatedly discussing two separate subjects together. So without too much reference to existing terminologies, let me offer three definitions.

Silviculture is the process of natural regeneration by harvest cutting plus those cultural practices required to maintain the health, vigor, and quality of growing stands and to anticipate or salvage the mortality which accompanies growth or action of destructive agencies.

For our purposes silviculture can be described in terms of the two broad basic systems: even-aged and all-aged. In practical application each of these is attained by one or more methods. For example, even-aged silviculture can be practiced by the seed tree, shelterwood, and clear cut block or strip methods; all-aged silviculture by the individual tree selection or small group selection methods.

Regulation is the scheduling of the rate and volume of harvest and intermediate cuttings so that the highest sustained production possible is attained from a working circle in the shortest practicable time.

Management is the integration of silviculture and regulation plus those economic considerations pertinent to a specific area that will assure attainment and perpetuity of the maximum sustained yield. Where commodities other than timber are to be produced, then additional specialties are encompassed under management and must be integrated with timber growing. The editorial in the March issue of the JOURNAL makes a good case for a concept of forest management analogous to the relatively new science of farm management.

Obviously silviculture is based on natural biological laws. The basic silvicultural system and method of practicing it must conform to the natural requirements of a given species or type. Failure to make a wise choice here will eventually result in failure to reach the objective of maximum possible sustained yield.

(Over)

The bases of regulation on the other hand are mathematics and judgment. Here miscalculation or lack of sound judgment may have equally serious results. With both of these fields having an important bearing on attainment of management objectives, it is perhaps unfortunate that our professional training approaches silviculture and regulation as separate specialties without too much attempt to bring them together. Some of our most difficult problems in management planning seem to arise from the need to give proper weight to each phase and thus effect a workable series of steps for management.

Effective practice of silviculture on the ground, as the procedure under which allowable cuts are taken, requires certain key decisions prior to field surveys and final calculations. These decisions are about as follows:

1. Determination of forest types and the age, site, or condition classes within each type which are to be mapped or sampled for volume and growth. The degree of refinement is dictated by the needs of regulation and differing silvicultural treatment. Beyond this the presence or anticipation of markets will have an influence on the stand classes to be recognized. Insofar as possible, the classification should be broadened beyond age class or stand size class to include concepts of silvicultural condition. Adequate condition classes based on silvicultural condition or needs are one of the best tools in getting good silviculture applied. Later on in the planning procedure, regulation calculations will tell <u>how much</u> can be cut but the mapping of these condition classes will tell us <u>where</u> it should be cut and the relative priorities of cutting. The more adequately condition classes can be conceived and mapped the more nearly will the cutting budget serve silvicultural as well as regulation needs.

2. Concurrently with this first step should go determination of the basic silvicultural <u>system</u>, i.e., even-aged or all-aged and the method of practicing it that will best meet the silvical requirements of the types or species to be managed. Economic considerations, logging methods, topography, and transportation systems will have a strong influence on the choice of <u>method</u> as well as the requirements of the species.

3. With these two steps completed as background, cutting or marking rules should be developed for the important type and condition class units with due regard for the shortest practicable cutting cycle. Such units should include those where products would conceivably be removed before the next plan revision. The rules should be based on the silvicultural needs of the units. Cut and leave tallies based on these rules should be a part of the field inventory. Sampling of this kind extended to both those stand units and tree sizes where regulation is contemplated and where products may be sold without regulation will determine the volumes that would be cut and left under desirable silvicultural practice. It may be necessary to modify the cutting rules later if the volume removed under them does not conform to the allowable cuts. Here is where the often necessary compromises between silviculture and regulation can best be made. The cut and leave tallies provide a reasonable amount of knowledge as to just what the compromise involves and how it can best be made.

4. Separate the products which could be removed under the silviculture contemplated into two categories: (a) those which experience, existing industries, and any reasonably well assured future developments show to have a steady, reliable market, and (b) those for which there is minor demand or which may enjoy a larger but sporadic demand. Also included in (b) should be those products for which a market may be anticipated within the near future. Products included in (b) will usually be of small size or low grade. For example, there are some areas with relatively assured markets for sawlogs, veneer logs, and stave bolts but with sporadic demand for pulpwood, mine props, or ties. The idea here is to plan on regulating the cut of those stands or tree sizes which produce the products finding ready sale; in addition, to have available the location of stands and the volume of these small products which could be cut under good silviculture when opportunity for sale arrives. This volume also indicates the markets which are needed and the promotion program required to get such material into use. The Ouachita National Forest is a good example of how fast markets for new products can develop and aid in improved silviculture. We need to be prepared for these markets and to hasten their development by being armed with the facts as to opportunities.

The discussion of the steps that will help in getting an integration of silviculture and regulation has been pointed at relatively intensive management. Where present conditions require extensive management, the difference in standards should be one of degree and not kind. That is, the attempt should be to attain the same balance of both silvicultural and regulation considerations rather than to sacrifice one.

Decisions and steps considered thus far for getting silviculture applied have been limited to what can be done by means of commercial sale. But there are other silvicultural needs which do not seem to fit quite as well into management planning. Noncommercial silvicultural measures such as weeding and pruning can be accomplished now mainly by K-V funds. This necessarily limits these treatments to areas previously cut. Where a plan has been in operation for some time and a backlog of K-V deposits built up, revisions of the plan offer an opportunity to review the needs on past cutting areas and to organize cultural measures on a planwise basis. Probably supplements to the management plan made at short intervals would be a more practical means of planning these operations.

Sizable areas exist which would benefit from these same cultural measures but cannot be touched with K-V funds. Other funds are usually inadequate to handle these situations and the apparent impossibility of doing anything about them may keep us from recognizing needs except when relief programs provide labor. Management plans could be made a device for estimating these needs but whether they or some other means offer the best promise of estimating the size of this job as a basis for seeking additional funds is a moot question.

NORTHEASTERN FOREST EXPERIMENT STATION
Upper Darby, Pa.

R-NE
SUPERVISION
Meetings
Management Plan Conference
March 28-April 8, 1949

March 23, 1949

Topic 9.--Applying Silviculture to Management Planning

Crop security: An essential element in timber management planning

It is fair to assume that the government will be growing timber on our national forests a thousand years hence. Our thinking and planning, therefore, should be not in terms of decades but centuries. Long range interests and problems should set the pattern of our planning. Forest management planning has dealt principally with problems of achieving regular sustained supplies of raw materials for local and national use. But the management policy should not ignore other beneficial influences these forests exert. National forests are often highly prized for recreation, for their protection value to sources of water, and their beneficial effects on stream flow and erosion. These factors contribute much to the health and well-being of the public and should receive due consideration in the shaping of management objectives.

This brings us face to face with the question of how best to promote and maintain conditions favorable to such uses individually or in the aggregate with a minimum of detriment to the forest. These conditions can be achieved only by cutting the forests in accordance with sound silvicultural principles. Too often forestry is treated simply as an engineering problem. Under such a regime, cutting operations leave large areas exposed to wind and water erosion. Soil porosity is decreased and recreational values seriously impaired; the very elements that give forests their value are destroyed.

Under mismanagement stand composition and quality deteriorate and forests become easy prey to a host of enemies. For example, clear cutting in spruce-fir forests in the past undoubtedly has greatly increased their susceptibility to budworm attack. Such cutting has fostered abundant regeneration of balsam fir, the favored host of the spruce budworm. Witness also the rapid spread of birch "dieback" and beech scale with its accompanying nectria in our northeastern hardwood forests. The serious inroads of these two pests stem back to the policy of consistently "creaming" the forests of their best trees leaving extensive areas dominated by cull and weakened trees--conditions ideal for the outbreak of native and introduced forest pests.

How can this tide of destructive agencies that threaten to curtail and impair the usefulness of the forests be held in abeyance? The answer lies in the application of sound silviculture. Through rational silviculture not only can the composition and thrift of the forest be improved but the very soil upon which the forest is so dependent can be maintained at a high level of fertility. Healthful fast-growing forests are the surest defense against external dangers.

Silviculturists believe that the attainment of productive resistant forests can be greatly facilitated by striving for stand compositions natural to the sites in question. They reason that the stable tree associations characteristic of climax types culminating through the play of natural forces are best adjusted to meet the impact of antagonistic factors. Such forests are inherently healthy and under good management are easily maintained in a high state of vigor, thus increasing their capacity to resist damage from insects and disease.

Flagrant disregard of this principle inevitably leads to serious trouble. We need point only to the deleterious effects on both the soil and the forest in growing repeated crops of pure spruce in parts of Germany. In this country the damage pure white pine stands sustain from the white pine weevil and the troublesome tympanis canker in pure red pine stands are classic examples of the violation of natural forest laws. In the climax associations, on the other hand, where these species normally occur in mixture with hardwoods and other associates, damage from forest pests is greatly reduced.

What does all this add up to? Does it mean that we should go all out for reestablishment of climax associations? Silviculturally such a goal may be desirable and under favorable circumstances readily attainable. Intervening factors, however, have operated to make immediate attainment of this goal over large areas impractical. Over extensive forest areas in the Northeast the conditions which produced the climax associations have changed radically. Fire, repeated clear cutting and cultivation have altered soil conditions to the extent that early establishment of species natural to the site may be difficult. Further, the impact of introduced foreign pests may necessitate striving for compositions differing from those that characterize the original site. But despite the obstacles encountered, compositions characteristic of climax associations should be used as guides for setting up silvicultural objectives. Such a guide is a sound approach for it recognizes the natural potentialities and tendencies of the site in question. Such silviculture produces healthy vigorous stands, the surest defense against forest pests.

These goals do not rule out legitimate attempts based on sound forestry to strive for subclimax species having higher market values than the original mixtures. Maintenance of such subclimax types as eastern white pine, some of the southern pines, Douglas fir, etc. are fully justified. The fact that species of the climax associations such as hardwoods in the case of pines succeed in establishing themselves in mixture should not be regarded as a silvicultural defeat. Conscious effort toward attainment of such mixtures is patent evidence of silvicultural skill and foresight. The skilled forester seeks every legitimate opportunity to work with nature rather than against her. He recognizes the limitations site conditions impose on his silviculture and adjusts his management practices accordingly.

Questionable silvicultural practices are frequently the result of economic pressure. Oftentimes choice of species and cutting methods are based not on site type tendencies but almost wholly on present and anticipated market demands. Such a policy in the long run is both economically and silviculturally unsound. To force a stand into a composition unsuited to the site is a costly undertaking. Further, such stands are likely to be highly vulnerable to insects, disease and other damaging agencies. Rather than try to forcibly adapt the forest to the industry the long range objective should be the development of industries whose raw material requirements call for the species which make up the natural composition of the forest upon which they depend.

True, accessibility, market demands and the needs of dependent industries should receive due consideration in the formulation of silvicultural policies. But when such policies threaten to undermine the goal of crop security they should be altered to assure attainment of this important objective. Crop security, however, is only too often complicated by inaccessibility of stands. To implement good silviculture we need permanent road systems. These make possible the frequent cuttings so essential to maintenance of stand thrift and the prompt development of pest resistant mixtures. High order forestry through the climax approach remains the key to crop security. But unless good silviculture is backed by proper forest planning attainment of this goal will be fraught with many difficulties.

M. Westveld

March 25, 1949

Topic 10 - Intensifying Management Practices

H. E. Ochsner
Division of Timber Management
W.O.

Let us first examine what we mean by the phrase "intensifying management practices". To me it means measures that will increase the quantity and quality of timber production; it means applying silvicultural practices that will develop the productive capacity of the land; it means protection from destructive agencies such as insects, disease, rodents, ruminants, and fire; it means developing the needed transportation systems and markets; it means carrying out cuttings so as to provide a sustained flow of timber for the support of communities and industries. In general such cutting, stand improvement and protection measures as will build the stands up to their maximum productivity in the shortest time possible consistent with the value of the timber production and bring about a proper distribution of age classes is what we are talking about. Only measures that can be carried out under existing conditions have a practical value to the forest manager. The cost should be justified by the future return.

Reappraisal estimates show an area of $73\frac{1}{2}$ million acres of commercial forest land in the national forests, exclusive of Alaska. 40 million acres, or 54%, is classed as sawtimber; 16 million acres, or 22%, as pole timber; 13 million acres, or 17%, as seedling and sapling; and 5 million acres, or 7%, as poorly stocked seedling and sapling and denuded. This is a rough classification of what we have to work with. The estimated total stand of sawtimber is 518 billion board feet or an average of approximately 7 M bd. ft. per acre. Since 1905 we have cut under commercial sales and exchanges about 81 billion board feet. This means that we have probably cut over between 10 and 15 million acres. We have $1\frac{1}{4}$ million acres of successful plantations. Exclusive of the area planted, most of the commercial forest land which this discussion is confined to, can be classed as wild forest, forests that have been established and developed naturally with little shaping by man. Some of the forests in the West have a preponderance of old growth stands and consequently carry a greater total volume than the optimum growing stock would be. Others, primarily in the East, are deficient in growing stock. Deficiencies in younger age classes, particularly in the medium age classes, the larger immature timber prevail in the West. There is a deficiency of older age classes, sawtimber size stands, in most of the eastern forests. Over-stocked immature stands in need of improvement cutting are increasing at a rapid rate in the east and in places in the west. There are unstocked and poorly stocked areas. Permanent transportation systems required for management are undeveloped or only partially developed in many areas. Markets are lacking for much of the material that should be removed to improve

productivity. Site, accessibility, ease of logging, and availability of markets vary greatly and determine the intensity of management that is feasible.

How then can the productivity of our forests be increased? Obviously, one of the first requirements to permit the marketing of trees that should be cut is an adequate road system. A primary objective of management, to be provided for in management plans, should therefore be the development of a permanent transportation system. The stumpage in the first cut in old growth stands has provided a means for the initial development of permanent transportation systems for many of our undeveloped areas. This requires careful planning in sales preparation. Where the stumpage in the initial cut will not carry the cost of development of the basic transportation system, road funds will be required.

Markets for the major portion of the timber available and in need of cutting are essential. If they are not presently available then the question arises, can they be developed. Before intensive effort is launched to develop a market we need to know what we have, and to obtain and analyze the best information available as to economic feasibility.

Commercial cutting operations provide the most important means for accomplishing the objectives of management. The silvicultural system to be followed in each type, whether even-aged management, or uneven-aged management must first be decided upon.

Where the selection or uneven-aged method of silviculture is to be followed we recognize the desirability of harvesting the mature and over-mature timber. This requires getting over those stands that have mature and over-mature trees in them as rapidly as possible in order to salvage these trees before they die. By making a light cut we can get over the area more quickly than if a heavier cut were made. An early return is then possible. As far as possible it is desirable to direct these cutting operations into the stands containing the most over-mature timber first. In ponderosa pine, insect susceptibility surveys have served to direct cutting into areas where greatest losses may be expected. In the northeast surveys of budworm susceptible balsam - fir stands have been made and a program of cutting is under way in these stands. The harvest of mature and over-mature timber constitutes but one phase of the operation. The reproduction of non-stocked openings and the openings created by cutting is another phase we are concerned with if we are to improve the productivity. We should also consider the time element, the time we can expect it to take to get natural regeneration. It may be desirable in some places to plan to plant if natural regeneration is uncertain or the average period of regeneration is so long that it would be profitable to plant. If natural reproduction is to be relied on, it is frequently necessary to insure that proper seed bed conditions are present. Such measures as prescribed burning, or mechanical scarification have been found necessary under certain conditions to insure good reproduction within a reasonable time. Spacing of the reserve stand

to provide adequate growing space should be considered in such cuttings. Commercial thinnings in the below-sawlog-sized material should be made wherever possible. Other measures that should be weighed from an economic standpoint are the removal of cull trees, the liberation of desirable young growth from over-topping weed species, non-commercial thinning, weeding, brush-replacement and pruning. When timber is damaged or killed by fire, insects, disease, wind or other cause, it should be salvaged wherever possible and provision made for artificial regeneration if necessary.

One phase of management that we know very little about as yet is the growing stock required to produce maximum growth. In order that we may properly plan our management we need to know what growing stock we should strive for.

Where even-aged management is to be applied, the size and location of the cutting areas becomes one of the most important considerations from the standpoint of silviculture as well as regulation. Large cutting areas are usually undesirable. The complete cutting series in a unit of area in which reproduction or harvest cutting is to be conducted should be laid out in advance. In order to maintain the productivity of an area it must be reproduced with a stocking and species composition at least as good as that existing at the time of harvest of the mature crop.

As previously mentioned, the area of young stands that would benefit from thinnings and other commercial and noncommercial improvement operations is increasing at a rapid rate. These young growing stands provide probably the best opportunities for increasing the future production in quality and quantity from the national forests. In order to accomplish the job wherever practicable, we must know where these stands are and have a sufficient knowledge of the volume that can be removed to proceed with marketing. These intermediate cuttings should be planned for and scheduled in the same manner as harvest cuts.

The foregoing brief discussion of some of the more important measures that must be taken if we are to increase the productivity of the national forests are undoubtedly rather elementary but none the less basic. All of them are measures being applied now some place on national forest lands. It is frequently not practicable to carry out needed and justifiable practices. We do not have many of the answers as to how to attain desired results. For example, we don't know how to get satisfactory sugar pine reproduction in some places. In other cases we know what to do but have not found or been able to obtain the means.

There are two phases to the job of intensifying management. The first is to insure that proper silvicultural measures are taken on the areas on which commercial cuttings are made. This requires adequate sale preparation. Satisfactory regeneration within a reasonable time must be assured. What if the expected natural regeneration fails? Provision should be made to obtain regeneration by artificial means in that event. We must also provide for

such care of the regeneration as is needed up to the time another commercial cut can be made. On selectively managed areas needed thinning, weeding and liberation cutting should be accomplished through sales or as an after-sale treatment with K-V funds. Follow-up within some predetermined period after cutting has been completed should be provided for. It was the purpose of cut-over surveys to provide that follow-up. If satisfactory reproduction was found to be lacking, facilities were usually not available to do anything about it. Follow-up examinations must be designed to provide the needed information without being unduly costly and burdensome.

The second phase of the job is to secure coverage of all the areas needing treatment during a period of time determined upon in accordance with regulatory requirements. Management plans are required to provide for such planned coverage. If our cutting practice is based on a twenty-year cutting cycle or the period between successive intermediate cuts is 20 years, getting over 1% each year of the total area in need of treatment obviously is not accomplishing the job. We would then be doing only 1/5 of what we should be doing. These of course are objectives to be striven for.

In order to intensify management practices on the national forests permanent transportation systems and markets need to be developed where these are lacking. Salvage or mortality anticipation cuttings in mature and overmature stands should be increased. We must insure regeneration within a reasonable time following harvest cuttings. Improvements cuttings and reforestation of nonstocked and poorly stocked areas should be increased. Losses from insects, diseases, rodents and ruminants must be held within tolerable limits. Intensive management requires working with the individual stand. It requires that proper cutting and stand improvement measures be applied to each stand at the right time. To accomplish this we need management plans.

March 16, 1949

# USE OF AERIAL PHOTOGRAPHS IN MANAGEMENT PLANNING

By: Albert W. Sump, Region 9

The use of aerial photographs by foresters has increased rapidly during the last ten years. All regions are using aerial photographs in varying degrees of intensity and are searching for new methods and techniques to further expand their use. The purpose of this paper is to point out the value of aerial photographs as a management tool and to present facts on their use in management planning.

## Specifications for Photography

Most of the existing photography available for use by foresters is panchromatic taken at a scale of 1:20000 with an $8\frac{1}{4}$-inch focal length lens. This type of photography is a compromise between the needs of the engineer and forester. Besides, a great deal of existing photography on the national forests, especially in the eastern regions, is over 10 years old and consequently of doubtful value for forestry purposes. Therefore, in order to secure the benefits that aerial photography can provide, new photography to forestry specifications is in order.

The kind of photography to specify depends on how it will be used. If it is to be used primarily for planimetric and topographic mapping, panchromatic photography at a scale ranging from 1:20000 up to 1:40000 may best serve the purpose. However, if the photography is to be used primarily for forestry purposes, and especially for cover mapping, it must show tonal contrasts between different cover types and be at a scale commonly used by foresters. In preparing specifications for new photography, the type of film and filter, season of photography and time of day, scale and focal length of lens, overlap, and kind of photographic paper are all very important and should be clearly specified in each contract.

In the Lake States Region, we have found that panchromatic film does not produce photographs with sufficient tonal contrast between forest cover types to allow us to do an accurate job of cover mapping with a minimum of field checking. This same situation exists elsewhere in the country where hardwoods and conifers occur in mixture or as intermingling pure types. I suspect that even in coniferous forests panchromatic film does not provide sufficient tonal contrast to identify various cover types. Region 9 has, therefore, selected infrared film modified by use of a minus blue filter on the camera. This combination produces sufficient tonal contrast between forest cover types for accurate cover mapping and retains to a large extent the definition of detail secured with panchromatic film.

The foresters' primary purpose in using photography is to prepare a good forest cover map at low cost. Consequently, in order to obtain maximum tonal contrasts between different cover types, especially when hardwoods are involved, photography must be secured while the trees are in full foliage. This requirement regulates the season of photography. Time of day is also important, as early morning and late afternoon photography produces excessive shadows on contact prints and makes interpretation difficult. To avoid excessive shadow, flying time each photographic day should be restricted to the hours between 9 A.M. and 3 P.M.

The scale of photography recommended for forestry use is 4 inches to the mile or 1:15840. This scale has been widely used by foresters in cover mapping and is large enough to enable interpreters to delineate areas to a size of $2\frac{1}{2}$ acres. Some regions may desire larger scale photography for particular areas or for a specific purpose, but generally 1:15840 photography is satisfactory. An $8\frac{1}{4}$-inch focal length lens has been generally used up to the present time, but there is some advantage in changing to a 6-inch focal length wide angle lens in relatively flat country. Photographs taken with a 6-inch focal length lens would provide a stereoscopic image of the area with the vertical dimension of the image more exaggerated than if taken with a lens of longer focal length. In flat country this permits more accurate measurements of tree heights and emphasizes elevation, which is considered in site determination as well as actual cover mapping. In mountainous country the $8\frac{1}{4}$-inch focal length lens or even a longer focal length appears desirable as a means of reducing topographic displacement.

The selection of photographic paper and the kind of prints desired depends on how the contact prints are to be used. Glossy prints are much sharper in detail than semi-matte prints but are difficult to write on with a colored pencil. They are, however, preferred for office work. Semi-matte, double weight prints are softer in detail and are better adapted for field mapping. They are easy to write on and are much more durable than glossy prints.

## Ground Control

Ground control is needed if accurate planimetric maps are to be prepared. The amount and kind of ground control depends on the topography of the country, the quality of the photographic job, and the standard to which the map is to be constructed. In the Lake States where topography is relatively flat, the amount of ground control can be reduced to a minimum. If G.L.O. resurveys are available and the location of corners and land lines can be identified on the photographs, the necessity of measuring control on the ground is eliminated. I will not attempt to cover the subject of ground control for planimetric mapping to recognized survey standards. This is a technical engineering job.

## Cover Mapping

Developments in aerial photography and techniques for their interpretation now make it possible to prepare an intensive cover map at a very reasonable cost in a short time. Most forest managers agree that an accurate cover map is extremely valuable in management planning, especially in laying out the order of cutting and maintaining records of past cutting. I am sure that all regions have prepared or are in the process of preparing cover maps for management planning. In this respect, I will outline the procedure being used in Region 9.

In 1947, Region 9 initiated an intensive management plan survey program designed to cover the entire region within a 10-year period. New modified infrared photography was selected for reasons previously outlined. Forest cover maps showing timber types, size classes and stand density are being prepared and then each timber type and condition class is sampled for volume and growth.

Prior to the start of a survey of this kind, a system of classifying the various timber stands must be established. This classification system must be so designed that each timber type and condition class to be recognized can be identified on the aerial photographs. For example, it is difficult to distinguish between aspen and paper birch, spruce and balsam fir and the various

species of northern hardwoods. Consequently, the aspen-paper birch type, the spruce-fir type and the northern hardwood type were established to permit the forest mapper to recognize these associations of species when viewed on the photograph.

The classification system adopted by Region 9 for use in the Lake States is similar to that used by the Lake States Forest Experiment Station in their forest survey. The classification recognizes thirteen commercial forest types, as well as thirteen cover types which are at present non-commercial from a forestry standpoint. Each commercial timber type is further stratified into four size classes (restocking, poles, small sawtimber and large sawtimber) and into three density classes (good, medium and poor).

Before the actual use of aerial photographs in forest cover mapping, certain preliminary office work is necessary to prepare the photographs for field mapping. The first job upon receipt of the photographs is to trim them and locate the principal and conjugate points on each contact print. The principal and conjugate points must be located accurately with a stereoscope. These points are used by the photo interpreter in orienting his pictures and in measuring tree heights by the Parallax wedge method, and are also important in the construction of the final maps. In order to insure full coverage of the area to be mapped, the mapping area is also outlined on every other print in each flight strip. There is usually sufficient overlap to permit mapping on every other photograph.

After the photographs have been prepared for field mapping, and photo interpreters have been trained, actual cover mapping may commence. Each photo interpreter is required to delineate on the mapping photograph cover types, size classes and stand densities to the standards set forth for the survey. Contrasting conditions are usually mapped to a $2\frac{1}{2}$ acre minimum and non-contrasting conditions to a 5-acre minimum. This detail in mapping is partially offset by a reduction in the number of sample plots needed to provide a pre-determined standard of accuracy. The closer the stratification the less variance within a condition class.

In the actual interpretation and mapping, each photo interpreter must use all of the photo interpretation aids and techniques as well as have a good understanding of cover type composition and how the various types occur on the ground in relation to each other. An intimate knowledge of the area being mapped is very helpful to the interpreter and enables him to distinguish cover types more accurately. Such photo interpretation aids as stereograms of the various cover types and condition classes, crown density scales and old maps of the area are all very helpful. However, as the interpreter becomes experienced he can more readily distinguish the identifying characteristics of each cover type and condition class and refers to the sample guides only occasionally. Interpretation devices such as the crown wedge for measuring crown widths, the Parallax wedge for measuring tree heights and various scales are all used in the actual interpretation job.

The classification of forest cover types from aerial photographs depends to a large extent on tone and texture, shape of the crowns, topographic location of the cover type and the interpreter's knowledge of the area being examined. While an attempt is made to secure photography with a minimum of variance in tone and texture between prints, photographic features do vary some for a given

cover type because of the influence of such factors as season of year, time of day, photographic development and stand density. Each interpreter must be able to recognize the influence of these factors and take them into account in his interpretation.

The determination of tree heights is important in the classification of stands into size classes. The Parallax wedge and shadow methods for height determination are most commonly used, although some interpreters are able to estimate heights of trees or stands by stereoscopic comparison with trees or stands of known heights. The comparison method requires field checks of heights prior to photo interpretation and the ability of the interpreter to classify within his mind certain depth perceptions viewed under the stereoscope. It is surprising how accurately stand size classes can be classified by the comparison method, after the interpreter becomes fully trained and experienced. In Region 9, both the Parallax wedge and comparison method are used. Each interpreter checks his depth perception with the Parallax wedge occasionally in somewhat the same manner as a timber cruiser checks his estimated merchantable height of trees with an Abney level or Biltmore stick.

Assuming that tree heights can be accurately measured on the photograph, the relationship between height and diameter of trees is a good indication of size class. When density of the stand and crown diameters are also taken into consideration, a more accurate estimate of stand size class can be made. Trees growing in dense to fairly dense stands are usually taller for a given diameter than trees in open grown stands. A table showing height range in feet by stand density for each major cover type and size class is a good guide for the interpreter. Of course, site must also be considered by the interpreter in size class determination. Trees found growing on poor sites will fall below an average height range and trees growing on good sites will fall above the average. The interpreter must, therefore, use considerable judgment in using average height ranges and must weigh all of the stand size class factors such as height, density, crown diameter and site in making stand size class determination. Our experience to date has shown that stand size class can be determined from the photographs in better than 95 per cent of the cases.

Stand density classification is perhaps the easiest part of the interpretation job. Stand density <u>can</u> be determined on the photograph by counting the number of visible trees by size class within a given area and then by use of a guide table of size classes determine within which degree of density the number counted falls. This method is not recommended, as it is difficult to secure an accurate count of the number of trees. The method used by Region 9 and by most photo interpreters to determine stand density is the degree of crown closure. Crown closure charts at photographic scale are valuable aids for density classification.

In addition to forest cover types and condition classes, the final map must contain all cultural and drainage features such as roads, trails, buildings, power lines, streams, marshes, lakes, etc. These are for the most part easily identified on the photograph. However, any cultural or drainage feature that cannot be easily identified with the naked eye should be emphasized by inking, since they are not easily seen on the photograph through map plotting machines.

After forest cover, cultural and drainage features have been properly classified in the office by the photo interpreter, the mapped photographs should be taken to the field for field checking. Field checking, to be of most value to the interpreter, should be done currently as the mapping job progresses and by

each photo interpreter. This checking enables the interpreter to correct any mistakes that occur in interpretation and in so doing trains the interpreter in recognizing timber types and condition classes that are difficult to interpret. We have found by experience that about 30 per cent of each interpreter's time should be spent in the field checking his mapped photographs and locating ground control such as section corners. This not only insures accurate work but also enables each interpreter to produce more work while in the office.

The final map preparation in section, township, or any other unit, is an engineering job. The photograph cannot be considered a map as scale may vary within the photograph because of topography and between photographs because of height in flying. When accurate planimetric maps are not available on which to superimpose the cover type data, the radial line projection method of map construction must be resorted to. Of course, if only a small area is being mapped, such as a section, and land lines can be located on the photograph, the radial line method need not be used. However, in most large areas even though recent General Land Office resurveys are available, the land lines and corners are not readily identifiable on the photographs and in order to tie the detail of the map together, the radial line method must be employed. Both of the above methods of map construction are being used in Region 9 in preparing township maps for management purposes. The scale of the finished map is 2 inches to the mile and it is printed in three colors - brown for cover type lines, blue for drainage features, and black for cultural features.

The above discussion outlines the procedure followed in Region 9 in preparing a forest cover map. The same procedure cannot be used with out-of-date photographs or with photographs that do not show tonal contrast between forest cover types. I wish to record here that time and money are saved in the long run by acquiring the type of photography needed for cover mapping rather than to try and do the job with old existing photography not designed for this purpose.

Volume and Growth Determination

When an accurate type map is available, the timber estimating job is greatly simplified. The area of each timber type and condition class can be determined and the number of plots necessary to yield a predetermined standard of accuracy for each timber type and condition class can be calculated. Area can best be determined from the map by use of an area dot grid. However, in relatively flat country where the photograph approaches a map, area may be calculated direct from the photograph. When mapped photographs are used for this purpose the possible errors in acreage should be recognized. In the western regions where topography is such a factor in photo scale, area must be determined from the planimetric map.

After the area of each timber type and condition class within a survey unit, usually a working circle, has been determined, the plots needed to yield a predetermined standard of accuracy can be laid out. The plots should be located on the map or on the photographs to avoid the possibility of bias. The plots needed for each timber type and condition class can be distributed on the basis of the area each plot represents. This method of distribution insures that the plots are distributed evenly over the area to be sampled. After the plots are located, the estimating crews can gather volume and growth data on each plot. In addition they can record the condition of the stand, its operability, site characteristics, recommendations for cutting, and any other data considered necessary for management purposes. With the completion of the plot survey, the data from the plots can be summarized and stock and stand tables prepared.

In this method of volume determination the photographs are used only to stratify the forest into fairly uniform condition classes and locate each. Thus, the placement of plots is simplified and the number needed for a stated degree of accuracy is materially reduced.

In Region 9, no attempt has been made to determine volume direct from the photograph. The Central States Forest Experiment Station has done some experimental work along this line but the results have not been in sufficient detail for our use. At best, only gross volumes can be secured and we have felt that until volume determination from photographs is further perfected, ground methods should be used.

Maps

Most forest managers will agree that type maps and planimetric maps are essential for good management planning. There is some question, however, in regard to topographic maps. They are generally considered in the "desirable" class and while useful they are the type of map the forest manager can dispense with in the interest of economy. Some of the western regions may challenge this statement because of the effect topography has on management. However, if topographic features are needed in laying out logging roads, sale area boundaries, etc., this information can be secured direct from the photographs.

Costs

The management plan survey in Region 9 has progressed far enough to provide a good index of costs. One national forest, the Chippewa, has been completed and two others are almost complete. The costs on all jobs, and we have three in progress at the present time, are very close to the cost figures for the Chippewa. In presenting the costs, I have purposely broken them down into the various phases of the job for analysis purposes.

Summary of Field Costs - Chippewa Timber Survey - Total Gross area 1,312,870 Acres.

| Items | Transportation Miles | Total Hours | Total Man Days | Cost Man Days | Total Cost | Cost Per Acre |
|---|---|---|---|---|---|---|
| New Photography* | | | | | $ 10,859.59 | $ .0082 |
| Type Mapping (Including field checking) | 14,815 | 5,349 | 665.5 | $ 9,109.01 | 10,363.29 | .0078 |
| Area Computation: Computing and Allocating Plots | 383 | 862 | 110.1 | 1,345.43 | 1,378.41 | .0010 |
| Plot Estimating & Tally Sheet Computation (3,697 Plots) | 10,182 | 4,674 | 592.8 | 7,175.47 | 7,856.61 | .0059 |
| Misc. (Including checking of Mapping & Estimating) | 327 | 91 | 11.3 | 197.47 | 217.09 | .0001 |
| TOTAL COST | 25,707 | 10,976 | 1,379.7 | $17,827.38 | $ 30,674.99 | $ .0230 |

*The photography cost $4.13 per square mile, somewhat higher than more recent photography costs. The high cost per acre is attributed to the large acreage of water within the Chippewa Forest, which is not included in the gross area figure.

The map compilation is handled by our Engineering Division and is averaging about 2.7 cents per acre making the total cost of the job exactly 5¢ per acre. There is a good possibility that this total cost can be slightly reduced. According to cost figures received from Regions 2 and 6 their costs range between 5 and 7 cents per acre.

Use of Photographs in Application of Plan

Aerial photographs are extremely valuable in the day to day application of management plans. They are used in locating roads, sale area boundaries, planting areas, and areas in need of stand improvement work, especially plantation release. They are also used in making volume estimates, intensive cover maps and for timber sale progress maps. In fact, they are used to good advantage in all phases of the job involving the orderly harvesting and management of the forest resource. We have found that enlargement of certain photographs to an approximate scale of 8 inches to the mile provide a very good working tool for forest officers on project sales. The ranger or timber sale officer can record the progress of marking, cutting, brush disposal, location of roads, etc., direct on the enlargement. Besides he can more easily explain the location of various kinds of cutting requirements to operators with this picture map than with a regular printed map. Region 2 has also found that enlargements are very useful for this purpose and I suspect that other regions are using enlarged photographs for the same purpose.

Under the heading "Volume Determination", I have briefly explained the method used by Region 9 in determining volume for management plan purposes. The stand and stock tables apply to the total area of a particular timber type and condition class within a working circle or survey unit. The accuracy of applying these average stock and stand tables to a specific area within the working circle is unknown. However, by knowing the average volume by species for each timber type and condition class one can adjust upward or downward for any particular area on the basis of composition, density and other factors influencing volume. The photographs are very useful in this respect as one can examine a specific area more closely than was done when the cover map was prepared. Besides, additional plots can be taken within the area to aid in adjusting the average stand and stock table. Experience to date indicates that for most timber types and condition classes the corresponding stock table for a working circle will apply reasonably accurate to any specific area of the same type and condition class within the working circle.

Summary and Recommendations

The above discussion regarding the use of aerial photographs for management planning emphasizes the following points:

1. Forest cover maps showing timber types, size classes, and density are essential in forest resource management.

2. Special photography for use in cover mapping is essential if an accurate cover map is desired at reasonable cost. The use of out-of-date photography, not adapted for use in cover mapping, is not recommended.

3. Modified infra-red photography at a scale of 1:15840 is recommended for forestry purposes, where hardwoods and conifers occur in mixture or an intermingling pure types.

4. The system for classifying forest cover must be so designed that each classification is identifiable on the photographs to be used.

5. Topographic maps are not essential in forest resource management.

6. Volume determination directly from aerial photographs is still in the experimental stage. For the present, ground sampling of volume for each mapped timber type and condition class within the survey unit is recommended.

7. The development of aerial photography for forestry purposes and its interpretation is relatively new. It is, therefore, recommended that there be a complete exchange of methods and techniques in photo interpretation between the regions and experiment stations. Perhaps the Washington Office should act as a clearing house for distribution of the above.

Assignees:
Sump, R-9
Krueger, R-2
Kirkpatrick, R-6

S
PLANS - R-2
Timber Management March 7, 1949

MANAGEMENT PLAN CONFERENCE - TOPIC II

## USE OF AERIAL PHOTOGRAPHS IN MANAGEMENT PLANNING

by Theodore Krueger

The outline furnished by the Washington Office for this subject asks certain specific questions. For the Central Rocky Mountain Region, the following applies:

### Type of Photography

Our flying in the past few years has all been done by contract, using an 8.25-inch focal length lens, a 1:20,000 scale, and panchromatic film. Flying is done at an elevation of 22,000 feet above sea level.

We find the 1:20,000 scale (3-1/6 inches per mile) a good compromise scale and useful for our purposes, although scales up to 1:12,000 would probably be of advantage in photo interpretation but would not be as useful to Engineering in ground control and preparation of the maps.

In our Region, photo interpretation is necessarily based on general appearance of a stand rather than on study of individual tree images or measurement of tree heights which is not practical in mountainous country; however, I can see where larger scales would be of advantage for photo interpretation in more level country.

Panchromatic film does not permit satisfactory differentiation between species. Panchromatic film sees green about the same as the human eye which is not very sensitive to changes in shades of green. I believe that for Timber Management plan purposes it would be worthwhile to carry on some experiments with use of modified infra red (minus blue filter) film. If results with conifers are comparable to hardwoods, as found on the Harvard Forest, we should be able to distinguish various species of pine, pine from spruce or fir, and mature stands from young stands which would be of great help in photo interpretation. In modified infra red photography, the older the stand, the darker the tone.

### Ground Controls

With our mountainous terrain, ground control is absolutely necessary before an accurate planimetric map can be made. This work in our Region is a technical engineering job and is done on the ground by the Division of Engineering and costs us about ½¢ per acre.

### Type Mapping

In Region 2 we have done 2 kinds of type mapping on photos:

1. By doing all of the mapping in the field, going to high points where large areas of country can be seen, drawing type lines on the map as seen and using a code symbol for each type; for example,

   Type 4 is ponderosa pine seedlings
   4a is ponderosa pine saplings
   4b is ponderosa pine poles
   4c is ponderosa pine intermediates
   4d is ponderosa pine mature.

   After type mapping is done, the estimators take the photos with them and make such corrections as might be needed; for example, the mapper may have called a stand "4c intermediates," whereas they find it to be a mature 4d stand.

   This method has worked out very well in our mountainous terrain, especially where we had only poor pictures taken years ago.

2. By doing office photo interpretation, putting type lines, etc., on the pictures in the office and then taking the pictures to the field and checking them. In using office photo interpretation, it must be clearly understood that prior to office photo interpretation, the only way to apply tonal value to any successful degree is for the interpreter to actually visit the various stands in the project with photographs at hand. He must obtain mental impressions of various stand conditions as they show on the photos. The accuracy of even broad photo interpretation requires some checks of photos against field conditions. This has certain advantages and certain disadvantages.

   a. <u>Advantages</u>

      (1) Where the pictures are good and definite tonal values can be established for various types, a creditable job of office interpretation can be done.

      (2) It gives an opportunity to determine the number of samples needed for the various condition classes in the project for the percentage of accuracy desired.

      (3) It gives a better picture of the total job ahead and helps in organizing, financing, and planning the project.

      (4) It might be sufficiently accurate for general Timber Management plan purposes where only a general type map is needed.

   b. <u>Disadvantages</u>

      (1) Where the photos are poor, office photo interpretation requires an undue amount of field checks and corrections, and often only a part of the photo can be typed in the office, and the remainder must be obtained in the field.

3. We believe that proper type mapping, classifying stand conditions in accordance with Timber Management needs in the area involved, is of prime importance for planning purposes. This can be accomplished at a reasonable cost by use of aerial photos. With an accurate type map as a base, giving areas by condition classes, we can:

   a. Take a small sample for general plan purposes and intensify the cruise on areas in the current budget period or as needed for sales.

   b. Even without a cruise, an experienced man in the type of timber involved, by having the acreage in each condition class, can get a fair estimate of the total volume, which is much better than many present guesses of volume on which some of our present management plans are based.

   c. If we have a good type map by condition classes but no cruise, the Ranger or Assistant can, as time is available, take sample plots and eventually build up a good estimate of timber volume on his District.

   d. A good type map giving areas of seedling and pole stands furnishes the basis of calculation of possible future yields.

Area Determinations

With mountainous terrain there is a great deal of distortion in the pictures. The effect of relief is to record areas at higher elevations with a larger scale than areas at lesser elevations. The following is taken from a discussion by Richard H. Blythe at the Petersham techniques meeting in 1946:

> "The seriousness of this bias depends upon the difference in the average elevation. Assuming an $8\frac{1}{4}$-inch lens, a 1:20,000 scale at base level, and a flying altitude of 13,750 feet above base level, the following table shows the bias in area estimates by simple dot grids for several differences in elevation:

| Average Difference in Elevation from Base Level | Actual Scale | Bias in Estimate of Area Compared to Area at Base Level |
|---|---|---|
| Base level | 1:20,000 | 0% |
| + 100 feet | 1:19,854 | +1.5 |
| + 200 feet | 1:19,709 | +3.0 |
| + 500 feet | 1:19,273 | +7.7 |
| + 800 feet | 1:18,836 | +12.7 |
| +1000 feet | 1:18,545 | +16.3." |

We often have differences of several thousand feet in elevation on the same photo. With an 8.25-inch focal length lens, flying at 22,000 feet, 1" on the map is equal to 975 ft. at 14,000 ft., but is equal to 1,575 ft. at 9,000 ft.

It will, therefore, be apparent that area determination in mountainous country cannot practically be made on the pictures themselves but becomes an engineering job using one of the various plotting machines available and then determine areas from planimetric maps to which the type delineations have been transferred.

This is a serious disadvantage in our type of country, as it delays the time volume computations can be completed for any one logging unit or project. This could be overcome by having a competent machine operator with the survey party who would map the types, etc., as mapping on photos is completed. This assumes that proper control had previously been established.

## Volume Determination

This cannot be done until the type map giving correct acreages is completed and no volume determinations are made in our Region directly from the photographs.

Due to the differences in elevation on the same photo, it is not practical in our Region to use crown diameters, parallax wedge, shadows, or other aids to determine volume. Our volume determination depends on ground work, using the plot or strip sampling procedures.

## Planimetric Maps, Type Maps, Topographic Maps

We must have type maps for our system of forest inventory and for management plan and control purposes. We have been using a 4" to-the-mile map. The difficulties of map preparation and control in our terrain with so much distortion in the pictures are such that map production is an expert's job and is handled entirely by our Division of Surveys & Maps.

We do the field mapping on the photos, and they prepare the type maps by transferring our type delineations from the photos to the planimetric base.

For our Timber Management planning we do not consider that topographic maps are essential, and none have been prepared by us for that purpose from aerial photos. They, however, are useful in detailed sales planning, such as preliminary road location, but some of this can be done by using the stereoscope.

We have not used mosaics for Timber Management planning purposes, but it is believed they could be made a useful tool in showing the proposed order of cutting for a period of years, as they would give an overall perspective of the entire Working Circle.

We have found that by outlining the part of the picture used for the planimetric map, it gives a quick reference to locating the picture in case we want to study it in connection with the map. (POINT OUT ON SAMPLE MAP).

## Survey Crew Organization

As we use more photo interpretation and sampling techniques and require the preparation of more intensive plans, we find that we require a high type man for Chief of Party and for mappers. The quality of any timber resource inventory depends almost entirely upon the good judgment, training and administrative experience of the man in charge of the crew. A man of P-3 or better qualifications should be selected for this position.

The Chief of Party needs to be a man experienced in Forest Service timber sale policies and cutting practices and needs to be a pretty fair logging engineer type, who can tell what is operable and what is inoperable, needed access road developments and their location, etc.

We can use students for volume estimates, but the mapper and Chief of Party need to be experienced men when you use aerial photos as basis for timber surveys.

## Use of Photos in Application of the Plan

Region 2 started using aerial photos for inventory purposes in 1938, and we are at the point where we do not even want to consider surveys unless we have aerial photos for the area; however, we are handicapped by not having the entire Region covered by aerial photos. For example, we are badly in need of a management plan for the San Juan Forest, where we must know how much pine for winter and how much spruce for summer operation we can cut annually and properly plan balanced operations as well as where to cut it, but may have to put our limited survey funds into aerial photos before we can make surveys and a usable plan.

Aerial photos where available are constantly used by us not only in management plan work but also in the planning and control of larger timber sale operations. For this purpose we have been experimenting some with use of enlarged photos of the area included in the sale. Enlargements have been on approximate scale of 8 inches to-the-mile. While it is realized that especially in mountainous terrain a photo is not a map, we find that enlarged photos on sales are valuable as a working tool for such items as showing

- Location of roads to be built
- Location of cutting blocks
- Location of areas marked or cut over
- Progress of brush disposal and showing location of various methods of disposal
- Location of areas to be thinned, etc.

Generally, you can explain location of various kinds of work to an operator better with a picture than with a map.

While aerial photos have limitations and must be supplemented by ground work, they offer a better opportunity than we have ever had before to accumulate management plan data at reasonable cost.

Costs in Region 2 are as follows:

| | |
|---|---|
| Aerial photography and 1 set of photos | 1¢ per acre |
| Field control and control map | ½¢ per acre |
| Timber survey - depending on intensity of volume estimate | 4-7¢ per gross acre. |

S
SUPERVISION
Meetings
(Management Plan Conference)

Topic 12 - Inventories for Timber Management Plans, Region 8

A. J. Streinz

## Character and Scope

The ideal inventory obtains the location and area of non-forest land, non-commercial forest land, and commercial forest land in the working circle, and obtains <u>for each separate stand</u> on the commercial forest land the following information:

1. Location.
2. Area.
3. Species composition or forest type.
4. Forest form: even-aged or uneven-aged.
5. Stand size class: large sawtimber, small sawtimber, pole-timber, saplings, and seedlings.
6. Density of stocking.
7. Age by 10-year or 20-year age class divisions for even-aged stands.
8. Site.
9. Condition.
10. Treatment past and future.
11. Net merchantable volume.
12. Increment.

In practice this ideal inventory must be fitted to the location situation with respect to the following:

1. Availability of suitable aerial photographs.
2. Character of the timber stands.
3. Planned forest practice.
4. Planned method of regulating the cut.
5. Available information.
6. Personnel and funds.

In many working circles in Region 8, the prevailing stands are young and middle-aged, second-growth and/or culled to cut-over old growth and second-growth. Forest practice is primarily the task of conducting intermediate cuttings, i.e., liberation cutting, thinning, improvement cutting, salvage cutting, and sanitation cutting. The stands may be grouped into two broad classes: operable and inoperable. Operable stands are those in which the yield from intermediate cuttings will support an economic logging operation for sawtimber or pulpwood or other products. The degree of cutting depends upon the condition of the stands. Regulation of cut is reduced to the determination of the period or cutting cycle, after which the compartments or logging units will support another round of intermediate cuttings. The planning of reproduction or regeneration cuttings is premature of this stage of timber management. Stands in which intermediate cuttings were made 5 or 10 years ago offer the best opportunity for the collection of

net merchantable volume and increment data for use in connection with the determination of the cutting cycle. Of equal interest and use is the net merchantable volume and increment in sparsely stocked stands of sawtimber and pole-timber size which, through growth, may become operable before stands subjected to intermediate cuttings will support another round of cutting. The utility value of the net merchantable volume and increment for other stands do not justify the determination of these data for subdivisions of the working circle.

The character and scope of the inventory for working circles just described depends upon whether or not suitable aerial photographs are available.

1. Aerial photographs available:

The inventory should always obtain the location, area, forest type, forest form, stand size class, and density of stocking for each separate stand in the working circle. These data are strongly correlated with stand operability and, when presented in the form of a stand map and stand tables by compartments, have a high utility value in timber management. These data facilitate the preparation of timber sales as well as the preparation of a cutting budget and plan. The cost and time required to obtain such type and stand class maps and stand tables are low in comparison with the high utility value. The costs for seven typical Region 8 working circles are:

| | | | Costs | |
|---|---|---|---|---|
| Working Circle | Acres | Man-days | Total | Per Acre |
| Angelina | 154,278 | 89 | $ 2,183 | $ 0.0141 |
| Bienville | 175,000 | 125 | 2,392 | 0.0137 |
| Biloxi | 117,200 | 117 | 1,733 | 0.0148 |
| Davy Crockett | 161,483 | 160 | 2,825 | 0.0175 |
| Homochitto | 189,000 | 141 | 2,728 | 0.0144 |
| Sabine | 184,427 | 102 | 2,462 | 0.0133 |
| Sam Houston | 158,155 | 117 | 2,730 | 0.0172 |
| | 1,139,543 | 851 | $17,053 | $0.0149 |

Age class and site class data, which are primarily of use in connection with planning reproduction or regeneration cuttings for even-aged stands, are not needed at this stage in timber management.

The condition and treatment of the stands by compartments or other subdivisions of the working circle are usually known, but may be supplemented by recording condition and treatment of specific stands checked for aerial photo classification or sampled for the determination of net merchantable volume and increment.

Net merchantable volume and increment should be obtained for each of those types and stand classes which have sufficient acreage and importance in timber management to justify a separate estimate. Other types and stand classes may be combined with related types and stand classes or may be omitted as seems best. Estimates should be obtained by sampling a number of stands in each type and stand class by the establishment of permanent sample plots to serve the dual purpose of obtaining periodic estimates of timber volume and increment in the future, as well as the current estimate of timber volume and increment.

The current cost of such estimates for three typical working circles in Region 8 are:

(a) Angelina Working Circle -- 154,278 acres

Number 1/5 acre circular permanent plots established 365

| | Total | Per Plot | Per Acre |
|---|---|---|---|
| Cost: Field - - - - | $1,589 | $ 4.35 | $ 0.0103 |
| Office - - - | 615 | 1.68 | 0.0039 |
| | $2,204 | $ 6.03 | $ 0.0142 |

(b) Biloxi Working Circle - 117,200 acres
Number 1/4 acre circular permanent plots established 212

| | Total | Per Plot | Per Acre |
|---|---|---|---|
| Cost: Field - - - | $1,536 | $ 7.24 | $ 0.0131 |
| Office- - - | 239 | 1.13 | 0.0020 |
| | $1,765 | $ 8.37 | $ 0.0151 |

(c) Sabine Working Circle -- 184,427 acres
Number 1/5 acre circular permanent plots established 809

| | Total | Per Plot | Per Acre |
|---|---|---|---|
| Cost: Field - - - | $5,539 | $ 6.85 | $ 0.0300 |
| Office - - - | 737 | 0.91 | 0.0040 |
| | $6,266 | $ 7.76 | $ 0.0340 |

2. Aerial photographs not available.

Available information is adequate for the determination of the location and area of most of the non-forest land, non-commercial forest land, and commercial forest land. The preparation of a type and stand class map for the commercial forest land is not feasible because of the character of the stands are unfavorable for ground mapping techniques. The compartments or other subdivisions of the working circle in which the prevailing stands are of sawtimber and/or pole-timber size can usually be identified on the basis of available information supplemented by some field reconnaissance. Compartments or other subdivisions which have been cutover 5 years or more in Forest Service sawtimber sales should be sampled to determine the net merchantable volume, increment, and cutting cycle. If the cutting cycle is 10 years or less, the balance of the commercial forest land carrying sawtimber and pole-timber stands should be sampled to determine the net merchantable volume and increment. If the cutting cycle is over 10 years, then the subdivisions selected to make up the 5 or 10 year cutting budget and plan should be sampled to determine the net merchantable volume and increment.

The character and scope of the inventory for working circles, where reproduction or regeneration cuttings are planned, depend upon whether the separate stands are to be managed and reproduced as even-aged stands or uneven-aged stands. If the individual even-aged stands are small or are ill-defined, it may be better to manage the stands as uneven-aged under a group selection silvicultural system. In this case the even-aged stands may be grouped to form arbitrary uneven-aged stands bounded by roads, topographic features, and land lines.

If the stands are to be managed and reproduced as even-aged stands, the inventory should provide the location, area, forest type, forest form, stand size class, density of stocking, age, site, condition and treatment for each separate stand in the form of a stand map and stand tables. The data are essential to the proper selection of even-aged stands for regeneration cuttings. Suitable aerial photographs should be obtained for this purpose in this Region before undertaking the planning of regeneration of uneven-aged stands. Sampling of the stands to determine net merchantable volume and increment must take into account the requirement of the planned method of regulating the cut. For example - -

(a) The allotment methods by area, by volume, or by area and volume with 20-year age class divisions require: the area, volume, and increment for stands over R years; the area, volume, and increment for stands between R years and R-20 years; the area, volume, and increment for stands between R-20 years and R-40 years.

(b) Hufnagls' method by area and volume requires the area, volume and increment for stands over R/2 years.

(c) Chapman's horizontal cut method requires: the area, volume, and increment of stands over R years, the area, volume and increment of stands between R years and R-cc years (cc = years in cutting cycle); the area, volume and increment of stands between R-cc years and R-2cc years.

If the stands are to be managed and reproduced as uneven-aged stands, the inventory should provide the location, area, forest type, forest form, stand size class density of stocking, condition, and treatment for each separate stand in the form of a stand map and stand tables where aerial photographs are available. The net merchantable volume and increment should be obtained by sampling a number of stands in each type and stand class. Where aerial photographs are not available, arbitrary land subdivisions bounded by roads, topographic features, and land lines are formed. In this event, the inventory provides the location, area, and the prevailing forest type, forest form, stand size class, density of stocking, condition, and treatment for each subdivision. The net merchantable volume and increment for all subdivisions are determined by sampling a number of subdivisions.

If some stands are to be managed and reproduced as even-aged stands, and some stands to be managed and reproduced as uneven-aged stands, then the inventory must provide the necessary information for both types of management.

Sampling of Net Merchantable Volume and Increment

Estimates of net merchantable volume and increment are obtained by sample plots. Each sample plot consists of two concentric circular plots: 1/10 acre and 1/5 acre. The tree tally on the 1/5 acre plot is limited to those trees that are of a size and quality to make merchantable sawlogs. The trees are tallied by species, 2-inch d.b.h. classes, and number of merchantable logs. The tree tally on the 1/10 acre plot is limited to those trees that are of a size and quality to make cordwood or pulpwood exclusive of those tallied as merchantable for sawlogs. The trees are tallied by species, 2-inch d.b.h. classes, and merchantable length or number of pulpwood sticks.

When suitable growth data are not available, the following data are recorded for each merchantable tree on the respective concentric plots: species, d.b.h. to nearest tenth inch, merchantable length, radial wood growth for 10 years, and single bark thickness on a pre-determined proportion of sample plots. These plots and data are used to determine by the "Least Squares Method" the relationship between periodic increment per acre and timber volume per acre.

Each sample plot is classified on the basis of the timber stand in which it falls as to forest type, forest form, stand size class, density of stocking, condition and treatment, and where the regeneration of even-aged stands is planned as to age and site.

When types and stand classes are mapped, permanent sample plots are established to serve the dual purpose of obtaining periodic estimates of timber volume and increment in the future as well as the current estimate. These plots are established in the type and stand classes which have sufficient acreage and importance in timber management to justify a separate estimate. The sample plots may be established as single sample plots or in groups of two or three. When the group pattern is used, the first plot of the group is established at a predetermined sample plot location and the auxiliary plots are located at a distance of 5 chains from the sample plot location on any bearing which permits the auxiliary plots to fall within the same type and stand class as the sample plot location.

The number of sample plots to be established depends upon the local variation in sawtimber volume on 1/5 acre plots, the desired sampling error, the desired probability that the sampling error will fall within the limits set, and funds available for the work.

Local variation in sawtimber volume on 1/5 acre plots is expressed in terms of standard deviation or coefficient of variation. Unless this information is available for the type and stand classes to be sampled, it is necessary to obtain estimates of standard deviation or coefficient of variation for the respective type and stand classes. Such estimates may be obtained from available data for plots taken in timber sale cruises of recent date or recent remeasurement data for permanent growth plots when individual plots and tallies can be correlated with mapped type and stand classes or by presampling.

Table 1 shows the method used to obtain estimates of the standard deviation, coefficient of variation, and number of plots required for three levels of sampling error for the Sabine National Forest from available plot data. Table 2 shows the type and stand class acreage and the total number of plots required for three levels of sampling error. On the basis of estimated cost of establishing the plots and the funds available for this work at the time the analysis was made, it was apparent that sampling errors of 5% or 10% for each type and stand class were not attainable. By setting the allowable sampling error at 10% for the sawtimber stands and 20% for the other stands, the number of plots needed is 881. Some further adjustments were made which reduced the total number to 809. These plots were established at the cost previously given. It is planned to determine the standard deviations and sampling errors for the plots and compare them with the estimates shown in Table 1. The primary objective of the sampling was to obtain the best attainable estimate of sawtimber volume for the average or mean 1/5 acre plot in each type and stand class. This estimate is the basis for calculating the timber volume:

a. for each type and stand class.

b. for each compartment or other subdivision.
c. for the Sabine National Forest.

Presampling to obtain an estimate of the standard deviation for a type and stand class requires a minimum of two plots taken at random from the total number of possible plots in the type and stand class but, for a fairly reliable estimate, probably 10 to 12 plots are needed. On this basis with many type and stand classes, presampling may easily become as large a task as the planned system of dual purpose permanent plots. This may be avoided by directing the presampling to those type and stand classes of sufficient importance to justify a separate estimate, and to the largest separate stand in the respective type and stand class. Instead of selecting the largest separate stand for presampling an alternative procedure would be to draw at random 5 separate stands from the total number of stands in a type and stand class and take 2 sample plots at random in each of the stands drawn. The sample plot locations are laid out on the 2 inches to 1 mile base map atlas sheets showing the type and stand classes. A sample plot location may be the location of a single sample plot or the location of the first of a group of two or three sample plots. After the number of plots required for a type and stand class is determined, the square spacing between sample plot locations to cover the type and stand class area is calculated. Usually many type and stand classes have about the same square spacing. For these a suitable single square spacing is selected. Dot grids on overlays of transparent acetate sheeting are prepared on the base map scale for the square spacing layouts of the respective type and stand classes. The dot grids are tossed on the base map atlas sheets showing the type and stand class. Dots falling on the type and stand classes to which the spacing applies are picked through the overlay onto the map. Each point represents a sample plot location. Each location is circled and numbered. Field notes are prepared for establishing the sample plot location by bearing and distance from starting points recognizable on the base map, aerial photographs, and ground.

When the type and stand classes are not mapped, the compartments or other subdivisions which have been cutover for 5 years or more in Forest Service sawtimber sales are sampled by the mechanical line-plot method. One hundred or more sample plots are taken on which data are collected for the determination of timber volume, increment, and cutting cycle. If funds are available and an up-to-date inventory for timber volume and increment is desirable, the balance of the commercial forest land carrying sawtimber and pole-timber stands is sampled by the mechanical line-plot method when the cutting cycle is 10 years or less, or when the cutting cycle is over 10 years, the subdivisions selected to make up the 5 or 10 year cutting budget and plan are sampled. The number of plots are determined from the best available data on the local variation in sawtimber volume, and funds available for the work.

The costs for the compilation of inventory data have been given for three representative projects in Region 8. These costs include the layout of the sample plot locations on the type and stand class map, preparation of field notes for locating the plots, compilation of plot data to obtain estimates of timber volume and increment. IBM machine compilation was not used because the number of plots involved in each case was small. It is planned to standardize the compilation methods and form of tables for presentation of the forest resource data.

TABLE 1 - ANALYSIS OF 2145 1/5 ACRE CIRCULAR PLOTS 1947 TIMBER CRUISE COMPARTMENTS 53, 54, 58, SABINE NATIONAL FOREST

| Type | Forest Form | Stand Class | Number Plots | Total Volume Bd. Ft. | Average Volume Per Plot Bd. Ft. | Range in Volume Per Plot Bd. Ft. | Ratio R/SD (1) | Standard Deviation Bd. Ft. (2) | Coefficient of Variation (3) | Percent Error Number of Plots (4) ≠ 20% | ≠ 10% | ≠ 5% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | E | 4a/3 | 4 | 8,960 | 2,240 | 5600-1000 = 4,600 | 2.06 | 2,233 | 100 | 25 | 100 | 400 |
| | | 4b/3 | 8 | 14,440 | 1,805 | 3830-260 = 3,570 | 2.85 | 1,253 | 69 | 12 | 48 | 190 |
| | | 4a | 8 | 12,280 | 1,535 | 2430-790 = 1,640 | 2.85 | 575 | 37 | 4 | 14 | 55 |
| | | 4b | 4 | 2,060 | 515 | 970-330 = 640 | 2.06 | 311 | 60 | 9 | 36 | 144 |
| | | 3a | 65 | 52;590 | 809 | 2430-20 = 2,410 | 4.69 | 514 | 63 | 10 | 40 | 159 |
| | | 3b | 106 | 77,390 | 730 | 2940-0 = 2,940 | 5.02 | 586 | 80 | 16 | 64 | 256 |
| | | 2a | 120 | 61,740 | 514 | 2620-0 = 2,620 | 5.03 | 521 | 101 | 26 | 102 | 420 |
| | | 2b | 121 | 50,640 | 418 | 1840-0 = 1,840 | 5.03 | 366 | 88 | 19 | 77 | 310 |
| | | 1 | 24 | 13,580 | 566 | 1450-0 = 1,450 | 3.93 | 369 | 65 | 11 | 42 | 169 |
| P | U | 4b3 | 211 | 318,620 | 1,510 | 3160-30 = 3,130 | 5.52 | 567 | 37 | 4 | 14 | 55 |
| | | 4c/3 | 106 | 119,840 | 1,131 | 3540-100 = 3,440 | 5.02 | 685 | 61 | 10 | 38 | 148 |
| | | 4b | 159 | 169,290 | 1,065 | 3300-90 = 3,210 | 5.33 | 602 | 56 | 8 | 32 | 126 |
| | | 4b/2 | 114 | 202,320 | 1,775 | 2970-90 = 2,880 | 5.10 | 565 | 32 | 3 | 11 | 41 |
| | | 4c | 18 | 15,150 | 842 | 1930-290 = 1,640 | 3.73 | 440 | 52 | 7 | 27 | 109 |
| | | 4c/2 | 28 | 29,130 | 1,040 | 2150-110 = 2,040 | 4.09 | 499 | 48 | 6 | 24 | 93 |
| PH | U | 4b/3 | 13 | 11,190 | 861 | 1470-180 = 1,290 | 3.31 | 390 | 45 | 6 | 21 | 81 |
| | | 4c/3 | 52 | 34,900 | 671 | 1930-0 = 1,930 | 4.50 | 429 | 54 | 11 | 41 | 164 |
| | | 4b | 702 | 667,360 | 951 | 5550-0 = 5,550 | 6.28 | 884 | 93 | 22 | 87 | 346 |
| | | 4b/2 | 124 | 100,790 | 813 | 2590-0 = 2,590 | 5.13 | 505 | 62 | 10 | 39 | 154 |
| | | 4c | 21 | 15,150 | 765 | 2280-0 = 2,280 | 3.73 | 611 | 80 | 16 | 64 | 256 |
| | | 4c/2 | 27 | 20,650 | 765 | 1740-0 = 1,740 | 4.09 | 425 | 56 | 8 | 32 | 126 |
| | | 3b | 56 | 47,210 | 843 | 1750-40 = 1,710 | 4.50 | 380 | 45 | 6 | 21 | 81 |
| | | 2a, 2b | 16 | 7,150 | 447 | 1300-0 = 1,300 | 3.47 | 375 | 84 | 18 | 71 | 282 |
| H | U | 4a,b,c | 27 | 23,720 | 879 | 2080-110 = 1,970 | 3.93 | 501 | 57 | 9 | 33 | 130 |

(1) Range/Standard Deviation from Table 5.5 Snedecor Statistical Methods.
(2) Range divided by ratio.
(3) Standard deviation times 100 divided by mean.
(4) Number plots for unlimited population to obtain estimate of volume on mean 1/5 acre plot with probability of 2 times out of 3 that percent error will not exceed those shown.
Number plots = coefficient of variation squared divided by percent error squared.

TABLE 2 - COMMERCIAL FOREST LAND AREA BY TYPE AND STAND CLASSES AND NUMBER OF SAMPLE PLOTS BY SAMPLING ERROR, SABINE N. F.

| Type and Stand Class | Acres | Sampling Error ± 5% Number Plots | Sampling Error ± 10% Number Plots | Sampling Error ± 20% Number Plots |
|---|---|---|---|---|
| PE 1 | 1,877 | 169 | 42 | 19 * |
| 2a | 5,920 | 420 | 102 | 26 * |
| 2b | 11,056 | 310 | 77 | 19 * |
| 3a | 2,819 | 159 | 40 | 10 * |
| 3b | 4,131 | 256 | 64 | 16 * |
| 4a | 103 | 55 | 14 * | 4 |
| 4b | 1,350 | 144 | 36 * | 9 |
| 4c | 133 | 109 | 27 * | 7 |
| 4b/2 | 15 (1) | - | - | - |
| 4c/2 | 15 (2) | - | - | - |
| 4a/3 | 695 | 400 | 100 * | 25 |
| 4b/3 | 1,294 | 190 | 48 * | 12 |
| 4c/3 | 287 | 148 | 38 * | 10 |
| PU 2a | 23 (3) | - | - | - |
| 2b | 410 | 400 | 100 | 25 * |
| 2c | 35 (3) | - | - | - |
| 3b | 1,924 | 256 | 64 | 16 * |
| 4a | 33 (4) | - | - | - |
| 4b | 29,109 | 126 | 32 * | 8 |
| 4c | 10,250 | 109 | 27 * | 7 |
| 4b/2 | 940 | 41 | 11 * | 3 |
| 4c/2 | 3,261 | 93 | 24 * | 6 |
| 4a/3 | 231 (5) | - | - | - |
| 4b/3 | 10,180 | 55 | 14 * | 4 |
| 4c/3 | 5,203 | 148 | 38 * | 10 |
| PHE 1 | 205 (6) | - | - | - |
| 2a | 352 (7) | - | - | - |
| 2b | 2,262 (8) | - | - | - |
| 3a | 168 (9) | - | - | - |
| 3b | 245 (10) | - | - | - |
| Sub-Total | 94,526 | 3,588 | 898 | 236 |

| Type and Stand Class | Acres | Sampling Error ± 5% Number Plots | Sampling Error ± 10% Number Plots | Sampling Error ± 20% Number Plots |
|---|---|---|---|---|
| PHU 2a | 337 (11) | - | - | - |
| 2b | 1,518 | 282 | 71 | 18 * |
| 2c | 40 (11) | - | - | - |
| 3a | 147 (12) | - | - | - |
| 3b | 1,394 | 81 | 21 | 6 * |
| 3c | 56 (12) | - | - | - |
| 4a | 15 (13) | - | - | - |
| 4b | 30,295 | 346 | 87 * | 22 |
| 4c | 19,298 | 256 | 64 * | 16 |
| 4b/2 | 2,560 | 154 | 39 * | 10 |
| 4c/2 | 9,744 | 126 | 32 * | 8 |
| 4b/3 | 2,284 | 81 | 21 * | 6 |
| 4c/3 | 2,339 | 164 | 41 * | 11 |
| HE 1 | 557) | - | - | - |
| 2a | 78) | - | - | - |
| 3b | 13) | - | - | - |
| HU 2b | 8) (14) | - | - | - |
| 3a | 93) | - | - | - |
| 3b | 656) | - | - | - |
| 4b | 7,642 | 130 | 33 * | 9 |
| 4c | 7,076 (15) | - | - | - |
| Sub-Total | 86,150 | 1,620 | 409 | 106 |
| | 94,526 | 3,588 | 898 | 236 |
| Grand Total | 180,676 | 5,208 | 1,307 | 342 |

(1) Combine with P4b
(2) " " P4c
(3) " " PU2b
(4) " " PU4b
(5) " " PU4b/3
(6) " " PE1
(7) " " PE2a
(8) " " PE2b
(9) " " PE3a
(10) " " PE3b
(11) " " PHU2b
(12) " " PHU3b
(13) " " PHU4b

(14) Omit
(15) Combine with HU4b

P - Pine predominating
H - Hardwoods predominating
E - Even-aged
U - Uneven-aged
1 - Seedling stand
2 - Sapling "
3 - Pole "
4 - Sawtimber "
a - Dense stand
b - Semi dense stand
c - Sparse stand
/3 - Operable for pulpwood
/2 - Operable for pulpwood in 10 years

* If allowable sampling error is set at ± 10% for sawtimber stands and ± 20% for other stands, the number of plots is as follows:

| | |
|---|---|
| Sawtimber | - 726 plots |
| Other | - 155 |
| Total | - 881 plots |

S
SUPERVISION
Meetings
(Management Plan Conference)

San Francisco, California
March 8, 1949

INVENTORIES FOR MANAGEMENT PLANS

TOPIC 12

Austin A. Hasel
Region 5

An inventory is required to provide the basic resource data needed for plans. This involves volume, growth, and area statistics.

Prior to the inventory the working circle and block boundaries should be fixed. Topographic maps are usually available, and these, together with consideration of transportation and location of manufacturing plants, govern the location of major boundaries. Compartment boundaries depend upon topography as it affects logging layout, but may be influenced partly by timber type, site, and condition. Inventory data may be needed before subdivision into compartments can be made or is necessary. In many cases examination of aerial photos will be helpful in deciding upon boundaries and in eliminating areas of inoperable timber and non-forest lands.

In planning the inventory, full consideration should be given to the use of existing cruise data. If the area has not been burned or cut over since the cruise, there is a good chance that the cruise can be adjusted to usable standard by a small amount of field checking.

Also, in narrowing down the job, full use should be made of Forest survey maps and plot data. In Region 5 these data include maps of age structure-crown density classes based on stereoscopic study of aerial photos, together with plot data that are additive to Forest Management data. The age-density class boundaries often coincide with type and site changes so that type and site can be entered on the map as various parts of the area are examined in the ground survey. It may be desirable to group site classes in this generalized mapping. With six site classes, three groups may be desirable.

## Accuracy Standards

Usually a standard is set for total volume, recognizing that the accuracy of the breakdown by individual species may be considerably less. The limit of sampling error should be set at the maximum that can be tolerated without changing the main provisions in the plan. Sometimes it is desirable to vary the intensity of sampling so that better estimates are obtained in the more important types and sites, or in accessible blocks where more intensive management is planned.

If the sampling error is set at 10 percent (two standard errors) for the working circle, the estimate by blocks will be rather rough. For example, for a

block making up one-fourth of the total, the sampling error will be around 20 percent. For plan purposes, however, it would be costly to aim at good estimates by blocks or compartments. The time to get more detailed information on these areas is just prior to the sale of timber or the undertaking of cultural work or planting. A detailed inventory plan should be prepared at that time.

Size, Shape and Arrangement of Plots.

The objective should be to use a sampling unit that is easy to establish on the ground and efficient from a sampling standpoint. Efficiency from a sampling standpoint means inclusion of the maximum of variability within plots and thereby reduction of variability between plots. A long, narrow plot extending uphill and downhill will generally be most efficient theoretically. Such plots will tend to have a narrower range of plot volumes than square or circular plots would have and, consequently, the standard deviation will be less.

On the Forest Survey in California, plots are 1 by 2 chains with length extending generally across the contours. The sampling unit consists of three such plots spaced 2 chains apart end to end. This shape of plot was adopted because of ease of establishment by two-man crews using a 2-chain trailer tape laid along the centerline. The size of sampling unit may be changed by taking more or fewer plots, keeping the same size of plot and spacing. On Forest Survey, in steep country, it was found that the three-plot sampling unit was the most efficient size. In other words, a given accuracy of estimate could be obtained in the least time. Besides, establishment of such a unit took at least a full crew-day in rough, inaccessible country. In areas near roads, two such units could be established in a day.

In easier country, such as in pine of the northeastern California plateau, it is contemplated on Forest Survey that one-man crews will be used and in this case circular plots will be preferable. The best number of plots to take in a sampling unit in this part of the State is yet to be determined.

To test for the best size of sampling unit, it is necessary to determine variance between and within sampling units, and from time records find the ratio of time required to establish a plot at a new location compared with time required to establish an additional plot at a location already occupied. The analysis of variance may be represented as follows:

| Source | Degrees of Freedom | Variance |
|---|---|---|
| Between units | n-1 | kA + B |
| Within units | n(k-1) | B |
| Total | nk-1 | |

where

n = number of sampling units,
k = number of plots per sampling unit.

By ordinary analysis of variance it is then easy to determine the value of $\underline{A}$ and of $\underline{B}$. Then if $\underline{r}$ is taken as the above-mentioned ratio of time, the optimum number of plots, $\underline{n}$, in a sampling unit will be

$$n = \sqrt{r \frac{B}{A}}$$

rounded off to the nearest whole number. A few days time in the office making such a calculation may result in considerable savings on an inventory project.

Strictly speaking, a valid estimate of sampling error is obtainable only from a random sample. This implies more than an unbiased sample. A rectangular grid pattern gives an unbiased sample, but the component plots are not random sampling units. However, we have found that plots spaced one-quarter mile apart in the same mapped class have negligible correlation and therefore we treat them as random. Anyway, exact evaluation of sampling error hardly seems necessary in this work if it is difficult for the user of the estimates to specify the accuracy required within one or two percent.

If the most accurate estimate of volume is desired from a given number of sampling units, they should be allocated to mapped classes according to the product of standard deviation and proportion of total area in the class. This is termed "optimum allocation." If desired, this can be readily done in Region 5 by using Forest Survey maps and standard deviation estimates by mapped classes. For illustration, let

$A_i$ = acres in the $i^{th}$ class
$p_i$ = proportion of total area in $A_i$
$s_i$ = standard deviation
$n$ = total number of sampling units to be apportioned
$n_i$ = number of sampling units that should be taken in the $i^{th}$ class

then

$$n_i = \frac{n(p_i\ s_i)}{\sum p_i\ s_i}$$

where $\sum p_i\ s_i$ is the sum of $p_i\ s_i$ for all classes.

This procedure would be advisable under the assumption stated. However, volume is not usually the sole variable of major importance. Sampling that is optimum for volume will not be optimum for growth. A good compromise for the present appears to be proportional sampling, taking equal spacing regardless of mapped class.

Another possibility is to convert individual plot volumes and growth expectation into dollar value and calculate standard deviation and averages. Then the optimum allocation method can be applied on the basis of values instead of volumes, thereby concentrating more effort on the more valuable parts of the area.

Location and Orientation of Plots.

There are obvious advantages in tieing plots to section corners if the plots are to be remeasured periodically. Present procedure in Region 5 inventories for management plans is to put a plot in each 40 adjacent to the section corner on a bearing of 45° from cardinal directions and 5 chains from the corner. If at 5 chains the plot is not wholly within a single mapped class, the location is moved beyond by 2-chain intervals until it is. The plot is oriented at a right angle to the contour at the beginning point and is taken in a direction away from the corner, whether uphill or downhill.

No plots are taken in 40's that do not enter into management calculations. Plots around a section may differ as to mapped class, such as type, site, or condition. For these reasons we will have sampling units that vary in size from 1 to 4 plots, inclusively. With plots spaced about 10 chains apart in these clusters, correlation may be expected and the variable size of sampling unit will have to be taken into account in calculating sampling error.

Plot Data

The measurements and observations taken on plots should be confined strictly to what is definitely needed, and the method of anlyzing the data should be set up at the time of planning the inventory.

For immediate purposes the estimate of volume in virgin stands or in other stands ready for cutting is important. In the long run, however, the inventories of growth, mortality, and changes in stand structure over periods of time are more important. It seems desirable, therefore, to use plots that are designed to give the essential data on both volume and growth.

For periodic determination of net growth, we use 1/5-acre plots that are essentially the same as those used by the Forest Survey. These are permanently staked and witnessed, and the trees are tagged. Forest Survey plots will provide a representative sample of all commercial forest land in the State with major timbered counties as the smallest breakdown. Survey estimates for a county will be of about the same accuracy as our estimate for a working circle. Within a working circle, use of Survey plots will increase our data by 5 to 10 percent. In addition, Survey gets increment core growth data and sample tree data for localizing form-class volume tables that will be useful in our inventory. Region 5 data, properly weighted by area, will strengthen Forest Survey estimates.

Including the 1/5-acre growth plot, we take a 2-by 5-chain volume and mortality plot in which the tally is confined to trees 11.0 inches d.b.h. and over. In virgin timber those larger plots provide the basis for budgeting the cut in the first cutting cycle. In cut-over timber they provide the estimate of mortality. Although the 1/5-acre plots will give a direct estimate of net growth by periodic remeasurement, the estimate of the components of net growth, i.e., gross growth and mortality, would be very rough. The larger area is needed to keep currently informed on mortality and development of poor-risk trees so that appropriate measures can be taken to salvage losses and potential losses.

Tally of pole-size trees and reproduction can be confined to small, but preferably long, narrow plots. Poles can be conveniently tallied on 0.2-chain strip along the centerline of the 1-by 2-chain plot. Reproduction may be noted on each milacre of the pole tally strip indicating stocked quadrats by dominant species, and whether under the crown of a larger tree. If the quadrat is unstocked it may be classified according to conditions affecting suitablilty for planting or direct seeding.

Site quality should be rated for each plot so that the most appropriate volume tables and growth tables may be applied. Individual plots or plot clusters may differ from the mapped site in which they are included, depending upon the minimum size of area that is mapped.

Any sample tree data, such as increment cores, height, and form class, should be taken on an area sampling basis rather than an individual tree basis. On an area selection basis the trees will be representative of the total stand. Taking a tree or a fixed number of sample trees per plot will give proportionately more open-grown trees than occur in the total stand.

Accuracy of Measurements

Sampling error, of course, usually represents just part of the accuracy actually realized. Biased measurements or use of volume tables that are not adapted to the timber often seriously affect accuracy. In past surveys, the tendency has been to cruise more intensively than necessary. Bias will tend to affect results by the same amount regardless of intensity of cruise. Some of the time saved by taking smaller samples can well be spent in reducing bias.

The question of when to measure and when to estimate depends upon the experience and ability of field crews. Sometimes it is better to measure sample trees accurately and use curves of height and form class over diameter rather than rely on estimates of larger numbers of trees.

Advantage should be taken of windthrows and felled timber to get scaled volumes for checking volume tables. Care should be taken to get a sample that is representative of all parts of the area being cruised.

Compilation of Data

First attention should be given to volume tables. All data taken for adjusting or localizing existing volume tables should be worked over. This involves a comparison of scaled volume with volume table figures within species by diameter and height classes. The adjustments may be represented graphically and applied to the tables.

It is desirable to provide space on the tally form for summarizing plot volume and number of trees by species, tree thrift class, and "cut" or "leave" trees. From these plot summaries a species-tree class stand and stock table may be compiled by type, site, and condition. Such tables suffice for immediate purpose of plan preparation. They provide the estimates needed in using the Dunning alignment charts for growth prediction, which involve reserve volume,

site index, proportion of sugar pine and white fir, proportion of volume in different tree classes, volume of the average tree, and size of the average pole. Separate estimates are made for gross growth of sawtimber-size trees, ingrowth, and mortality. The estimates apply to the main conifer species only, without segregation by species.

At some later date, however, stand structure by diameter class will be needed in addition to species and tree class. By establishing plots prior to cutting, or by tallying stumps if the initial survey is made after cutting, stand and stock tables can be prepared for the stand prior to cutting, immediately following cutting, and periodically after cutting. Assuming that the stand structure of the regulated stand being aimed at is known, it will be possible to measure progress toward attaining the regulated stand structure.

As records of periodic net growth are obtained, the results will be used in place of the preliminary alignment chart prediction and plans can be revised accordingly if differences are significant.

Forest Survey expects to provide volume growth tables comparable in format to volume tables by species, site, and tree class groups. These will give growth by Scribner, the International 1/4" rule, sawlog cubic volume, and total cubic volume. All tree species are included, hardwoods as well as conifers. These Forest Survey growth estimates will also be checked by our periodic inventories of the permanent plots and considered for use in predictions for management purposes. These estimates will be valuable in stands outside the range represented by the alignment chart method and within the range for comparison with alignment chart predictions. Also estimates will be provided by individual species.

It may become desirable in the future to express volume by International 1/4" rule or by cubic-foot units. This can be done very quickly by use of diameter class stand and stock tables and application of converting factors that are curved over diameter.

The summary of volume by plots and then by sampling units provides the basis for calculating sampling error. Knowledge of the sampling error is important in deciding upon the reliability of estimates by individual species, the probable range of "cut" volume, the minimum size of subdivision for which the estimates may safely be used, and for improving the efficiency of future inventory work.

Areas will usually be obtained from maps that show age structure-timber density, type, site, and condition. Some of the Survey age-density classes may be combined for our purposes, and in making ground surveys we will have to enter type and site on the Survey map. Areas as mapped will be determined by planimetering, line sampling, or dot count. Without a map, the proportion of field plots in different classes provides an estimate of the proportion of total area in each class, if the spacing of plots is uniform. On most of our surveys, the number of plots in a working circle will be too few to provide anything more than a very crude estimate by this method.

Possible Shortcuts

At present the minimum number of plots is set at 200 in the smaller working circles. Highest priority is given to cut-over areas and restocking burns to get net growth and mortality data for plan revision. The next highest priority is given to virgin timber scheduled for early cutting. The average number of plots taken in a cluster is three and represents a day's work for a two-man crew. It is planned to check on the adequacy of 200 plots and decide upon the ultimate number needed in each working circle. This can be done on a volume basis at present, but it will be preferable to decide this finally according to variability in mortality and net growth.

Maximum use will be made of existing cruises, most of which were 5-or 10 percent strip surveys. In adjusting these to present standards, the old strip lines will be duplicated as closely as possible. The smallest recording unit was the 40, so it will be necessary to re-run on a 40 basis, selecting a representative sample of 40's.

Another good possibility of getting preliminary estimates for plan preparation is to use Forest Survey's average volumes by mapped classes and apply these with some adjustments to local areas. This has been done with good success in a few instances, but further tests are needed.

Use of Forest Survey volume tables localized to species, site, and perhaps tree class groups and applied on the basis of diameter only may speed up plot establishment by eliminating estimation of height. These tables may be particularly useful in interpolating for growth.

The tedious and time-consuming job of planimetering maps may be eliminated by line sampling or counting dots. It is possible to show by straight line graphs on logarithmic paper the spacing of parallel lines needed to any given accuracy that is required.

Planning the most efficient inventory presents a different problem for each working circle. Existing cruise and map data, including Forest Survey, should be carefully examined so that full use is made of it. Forest Survey statistics on volume and variance, together with similar information from management plan cruises in comparable areas, should lead to progressively better and more efficient inventory work.

Austin A. Hasel

S
SUPERVISION
Meetings
(Management Plan Conference)

March 22, 1949

## TOPIC 12
## INVENTORIES FOR MANAGEMENT PLANS - R-4

By Paul A. Grossenbach

### Purpose

To obtain and assemble information pertaining to the timber resource in order to be able to regulate the cut and to safeguard future yields.

### Needs

(1) The total timber volume by (a) species, (b) age classes, (c) d.b.h. classes, and (d) types.

(2) The total area of forest land within the unit by timber types for (a) age classes, (b) merchantability classes, and (c) site classes.

(3) Tree class distribution where possible (such as Keen's class for ponderosa pine).

(4) The stand per acre of trees below merchantable size by d.b.h. classes for (a) merchantable types and (b) types now unmerchantable but which may become merchantable within the rotation.

(5) The predicted annual or periodic growth for the unit.

### Classification of Working Circles

We have tentatively classified our working circles into three broad groups in order to tie the needed inventories in with the relative values involved. (These classes were developed as a part of the regional 10-year program for management plan completion and it is necessary to explain them somewhat before discussing surveys as the type of survey required for each class varies somewhat from the others).

Class I. - Plans or revisions urgently needed; maximum allowable cut in sight, reached, or exceeded; available data either unsatisfactory or incomplete; relative importance high; project work required in most cases.

Class II. Plans or revisions needed; maximum allowable cut possible; additional or improved inventory data necessary; relative importance medium; surveys can be handled by contributed time with minor expense.

(Over)

Class III. No immediate need for better plans than are now in existence or can be prepared from data available; present cut generally far below maximum permissible; relative importance low; little or no field work required.

Relative values and relative importance are practically synonomous although importance ties the working circle in with community aspects and in some cases relatively low value timber may be involved where community dependence is high.

An indication of the nature of the inventory needed for each working circle is derived directly from this classification. Generally speaking we have our sights set on a relatively high standard survey for the Class I working circles. Such a survey will not be attempted without complete or nearly complete aerial photo coverage of the areas to be cruised although in some cases it will not be possible to await the construction of a planimetric base map by the Division of Engineering before proceeding with the survey. In such cases the ground crews will locate and identify on the photos the control needed, and the best available base map will be used to prepare the type map from the photos, using the KEK plotter.

Random sampling will be used throughout such a survey because of the large acreage involved. The system to be used will depend on the type of area to be covered.

As we have not yet used aerial photographs and random sampling on extensive survey work we cannot say definitely what refinements we will use. We do know, however, that we can stratify our timbered areas on the photos and without much field work, by density and age classes and in some cases by types. This will allow the use of stratified random sampling and we certainly intend to try it for we feel that there is at least one very distinct advantage in stratified sampling and that is that where an entire working circle is covered in this manner we can still obtain reasonably good compartment estimates due to the delineation of densities and age classes on the photos.

The procedure we expect to follow will be somewhat of the following order:

(1) If an aerial photo planimetric base map is available, no additional control will be necessary and advance field work will consist of typing age and merchantability classes on the photos, using stereoscopes and binoculars and typing from vantage points. If no aerial photo base map is available, the necessary control points will be located and pin pricked on the photos. As far as possible the typing will be done in conjunction with the control work, and whatever blank spaces are left will be filled in from vantage points. No units less than 10 acres will be typed out.

(2) Density classes will be filled in next, working in the office and using a stereoscope.

(3) A rough determination of area by types, age classes and density classes for the merchantable timber areas will then be made.

(4) A random allocation of plots will follow. The number of plots to be taken will be determined by the uniformity of the plots within each age and density class for each type. Where no information on uniformity is available it will be necessary to do a small amount of sampling in each class in order to set the numbers required. In general there will be some cruise data available for the working circle from which the total number of plots required can be computed. Plots will be allocated according to density classes in order to attain the lowest sampling error in the heavy density classes and the estimate for the light density classes will suffer accordingly.

(5) Field sampling will follow as the last step in gathering the inventory data.

On parts of a very few Class I working circles present data can be considered sufficiently accurate that office revision of the old plans will suffice for the next few years. For those working circles new or revised plans will be made which will be expected to do until field checking of the assembled inventory data shows the need for more accurate figures. Procedure then will be the same as shown above for Class I areas unless enough of the present available data is found to be sufficiently accurate that the remainder can be gathered safely within the ten-year period by Class II procedure, shown below.

Class II working circles may be those where plans can be made or revised from existing data or where, because they are somewhat less important than those in Class I, the needed data can be gathered by less costly methods than Class I as the relative accuracy required is somewhat lower.

As there is not the pressing need for an inventory as accurate as that needed for Class I working circles, the survey standards can be somewhat less exacting. Aerial photos will be required as before but the amount of identification of ground control points on the photos will be reduced thus putting a heavier burden on the plotter operator who will make the best type map he can using the best available base map and using drainage for control as necessary.

Field work in typing and sampling will be done to as high a standard as with Class I, the difference being in the amount of sampling required. In other words, the quality of the work will be the same but the quantity will be reduced and the allowable error of the total estimate will therefore be increased accordingly. In both cases the percentage of error will be agreed upon beforehand and may vary between species within a working circle and also between working circles. Most of the work will be done by contributed time of ranger and timber sale personnel.

(over)

Class III plans will be made from estimates ranging in accuracy from the lowest Class II down to ocular estimates. Where aerial photos are available and can be financed on the forests, they will be used to the fullest extent possible. Little or no field work will be required. Plans will be based on the best available data ranging from worked-over extensive and intensive surveys down through the old reconnaissance estimates to "best judgment" estimates for some working circles. In most cases something better than a guess will be available though it might only consist of a few scattered timber sale estimates and maps that can be used for comparison purposes.

Relative Accuracy Required

For Class I and Class II surveys and plans the percent accuracy desired can be set beforehand. Based on two standard deviations the allowable error will probably range from about 5% to 10% for Class I and 5% to 20% for Class II. All survey data will be gathered, compiled and kept separate by compartments for convenience of revision and for planning the logging operations although the accuracy of the individual compartment estimates will be unknown.

It will, of course, be impossible to set any standards of accuracy for the Class III plans.

In Region 4 we have not had sufficient experience with the application of random sampling procedure to inventory methods to say what the allowable error should be for the various types and age classes that will be encountered beyond setting the broad limits of 5% to 20%. Before work is started on any working circle, the survey procedure will be planned in detail and the judgment of those men preparing the plan will determine the accuracy required for types and age classes. Site cannot be considered because no mapping of sites will be done.

CLASS I WORKING CIRCLES

Acreage Data

| Forest | Working Circle | M. Ac. Approximate Total Area | Priority Rating |
|---|---|---|---|
| Boise | Cascade | 144 | To be |
| " | Squaw Creek | 75 | set up |
| " | N. Fk. Payette | 27 | later |
| " | S. Fork Payette | 705 | |
| " | Boise Basin | 340 | |
| " | N. Fk. Boise River | 247 | |

## CLASS I WORKING CIRCLES (Continued)

Acreage Data

| Forest | Working Circle | M. Ac. Approximate Total Area | Priority Rating |
|---|---|---|---|
| Boise | Mid. Fk. Boise River | 276 | |
| " | S. Fk. Boise River | 391 | |
| Dixie | Mammoth | 371 | |
| " | E. Fork Sevier | 196 | |
| Payette | S. Fk. Salmon | 267 | |
| " | Payette Lakes | 109 | |
| " | Cascade | 32 | |
| " | Meadows Valley | 144 | |
| " | Salmon River | 100 | |
| Wasatch | Provo River | 140 | |
| Uinta | " " | 101 | |
| Total | | 3,665 M. acres | |

## CLASS II WORKING CIRCLES

| Forest | Working Circles | M. ac. Approximate Total Area | Priority Rating |
|---|---|---|---|
| Ashley | 5 | 1,116 | |
| Boise | S. Fk. Salmon River | 115 | To be |
| Bridger | 3 | 1,710 | determined |
| Cache | 2 | 1,217 | later. |
| Caribou | Snake River | 620 | |

(Over)

CLASS II WORKING CIRCLES (Continued)

| Forest | Working Circles | M. Ac. Approximate Total Area | Priority Rating |
|---|---|---|---|
| Caribou | Bear Lake | 70 | |
| " | Star Valley | 115 | |
| Caribou | Portneuf-Poc.-Malad | 276 | |
| Dixie | Escalante-Teasdale | 667 | |
| Mono-Toiyabe | Mono | 613 | |
| Nevada | Charleston Mountain | 62 | |
| Payette | Council | 219 | |
| " | Mann Creek | 29 | |
| " | Indian Valley | 41 | |
| " | Middle Valley | 47 | |
| Salmon | Northfork | 300 | |
| Sawtooth | South Fork Boise | 414 | |
| Targhee | Spencer | 184 | |
| " | Island Park | 460 | |
| Wasatch | Green River | 183 | |
| Uinta | Strawberry | 391 | |
| " | Duchesne | 138 | |
| Total | | 8,987 | |

CLASS III WORKING CIRCLES

Total area 20,112 M. acres consisting of the remainder of R-4 total gross area.

Present figures for volume and accessibility do not mean much at this time as all existing management plans are due to be revised and new plans are to be prepared where none are now in existence.

Costs

No extensive inventory work in the Region using aerial photos has been completed to the point where usable cost data is available. For estimating purposes we are falling back on figures given by other Regions. Our best estimate at the time is therefore 3¢ per acre for the Class I surveys and a total of approximately $110,000. At least 90%, and possibly more of the Class I area, is covered by usable aerial photography and the cost does not include the purchase of original photography, only the cost of prints of existing coverage, nor does it include the cost of Engineering control as it will not be possible to hold up the preparation of plans pending the completion of high order control work.

Class II surveys will necessarily be done with contributed time throughout with little additional expense except for photos and travel. This should amount to an average of less than 1/8¢ per acre with a total for Class II surveys of approximately $11,000.

Class III plans will require no formal surveys and no outlay of funds.

The use of aerial photos is of course the biggest dollar saver in extensive inventory work. Stratified random sampling, with the density delineation done as office work, should serve to reduce costs somewhat by cutting down the total number of plots to be taken. If practical, some system of plot clusters can also be used to cut costs.

This will be tried out, especially where the types are not too small. We can save considerable time by having compass courses and distances from easily identifiable points to plot centers laid out beforehand on the photos. These can be taken roughly from the photos by the use of the protractor and scale. This will of course be necessary only where plot centers will be difficult to locate directly from the photos.

We cannot at the present time see where the use of a card system and tabulating machines will help us much on compilation as we do not contemplate the use of continuous inventory nor the setting up of enough permanent sample plots to justify such methods.

Area control also appears to have a place in the preparation of at least some R-4 plans. It may be entirely feasible and all that we need at present for some of our lodgepole and spruce stands. A combination of volume and area control can probably be used for other areas. Straight area control has yet to be tried in R-4, although we have plans in preparation and some up for revision that will use some modifications of it.

Portland, Oregon
March 23, 1949

# THE USE OF YIELD TABLES IN PREDICTING GROWTH, MORTALITY, AND YIELD

By

Philip A. Briegleb
Pacific Northwest Forest & Range Experiment Station

A normal yield table is a tabulation of the volume, basal area, number of trees, etc. per acre found in full stands on specified sites at specified ages. Most normal yield tables have been prepared to apply strictly to even-aged, pure stands. Frequently, they have been considered as a guide to the life history of the ideal stand for the species studied. Actually, the theoretical normal stand seldom possesses this significance. It is merely a standard to which an actual forest may be compared. An example for site quality class II Douglas-fir is given in table 1.

## Application

The process for estimating annual growth, using yield tables, is simple in principle. Assume, for example, that an estimate of growth of a 50-year-old stand on site II over the next 10 years is desired. A common method is to obtain the following data from the yield table and by actual stand inventory respectively:

| | | |
|---|---|---|
| Normal volume | 60 years = | 42,800 bd. ft. per acre |
| " " | 50 years = | 27,400 " " " " |
| " 10-year growth, age 50-60 | years = | 15,400 " " " " |

Table 1.--Normal yield table for Douglas-fir on fully stocked acre site quality class II lands
(From U. S. Dept. Agric. Tech. Bul. 201)

| Age (yr.) | Av. ht. of dominant & codominant trees | Total number of trees | D.b.h. of average tree | Total basal area | Volume | | Mean annual increment, trees 12"+ |
|---|---|---|---|---|---|---|---|
| | | | | | Trees 6"+ | Trees 12"+ | |
| | Ft. | | In. | Sq. ft. | Cu.ft.1/ | Bd.ft.2/ | Bd. ft.2/ |
| 20 | 44 | 880 | 4.5 | 98 | 960 | -- | -- |
| 30 | 78 | 555 | 7.0 | 150 | 3,270 | 2,600 | 87 |
| 40 | 102 | 385 | 9.4 | 189 | 5,990 | 11,900 | 298 |
| 50 | 119 | 290 | 11.8 | 217 | 8,300 | 27,400 | 540 |
| 60 | 132 | 228 | 14.0 | 241 | 10,360 | 42,800 | 714 |
| 70 | 144 | 186 | 16.0 | 260 | 12,140 | 57,200 | 820 |
| 80 | 154 | 159 | 17.9 | 276 | 13,700 | 70,000 | 878 |
| 90 | 163 | 138 | 19.6 | 290 | 15,040 | 81,000 | 900 |
| 100 | 170 | 123 | 21.2 | 302 | 16,130 | 90,400 | 902 |
| 110 | 176 | 111 | 22.6 | 313 | 17,030 | 98,300 | 894 |
| 120 | 181 | 101 | 24.0 | 322 | 17,770 | 105,100 | 876 |
| 130 | 185 | 94 | 25.3 | 331 | 18,420 | 111,000 | 851 |
| 140 | 188 | 88 | 26.5 | 338 | 18,990 | 116,300 | 830 |
| 150 | 190 | 82 | 27.7 | 346 | 19,500 | 121,200 | 808 |
| 160 | 192 | 78 | 28.9 | 353 | 19,990 | 125,700 | 786 |

1/ Inside bark to 4" top.

2/ By Scribner rule to 8" top.

Present volume, as measured by cruise, is 23,300 board feet per acre, or 85 percent of normal. Estimate of current annual growth is then assumed to be:

$$\frac{(\text{Normal 10-year growth})\ \text{present volume as \% of normal}}{10} =$$

$$\frac{(15{,}400)\ .\ 85}{10} = 1{,}309 \text{ board feet per acre per year}$$

Measurements, on both permanent and temporary plots, of growth in actual stands show that young forests, typically less dense than normal, grow more rapidly than their percentage of normal volume indicates. This is shown in table 2 for Douglas-fir on well-stocked areas, averaging 85 percent of normal number of trees for actual stand diameter, and on medium-stocked areas averaging 55 percent of normal. Table 2 indicates that Douglas-fir well stocked at 50 years is expected to produce 97 percent of normal yield table growth during the next decade, or:

$$\frac{(15{,}400 \text{ bd. ft.})\ .\ 97}{10} = 1{,}494 \text{ board feet per acre per year}$$

This is an increase of 14 percent over the 1,309 board feet as estimated by the conventional method above. For medium-stocked areas supporting younger stands, failure to allow for an increase in normality percentage when estimating growth may lead to underestimates in error by as much as 100 percent.

In older second-growth stands, however, on well-stocked areas, actual increment tends to fall below that estimated from the yield table if appropriate correction factors are not applied. This is due largely to tree mortality, caused by insects, root and butt rots and storms, which tends to accelerate beyond the normal rate as stands grow older.

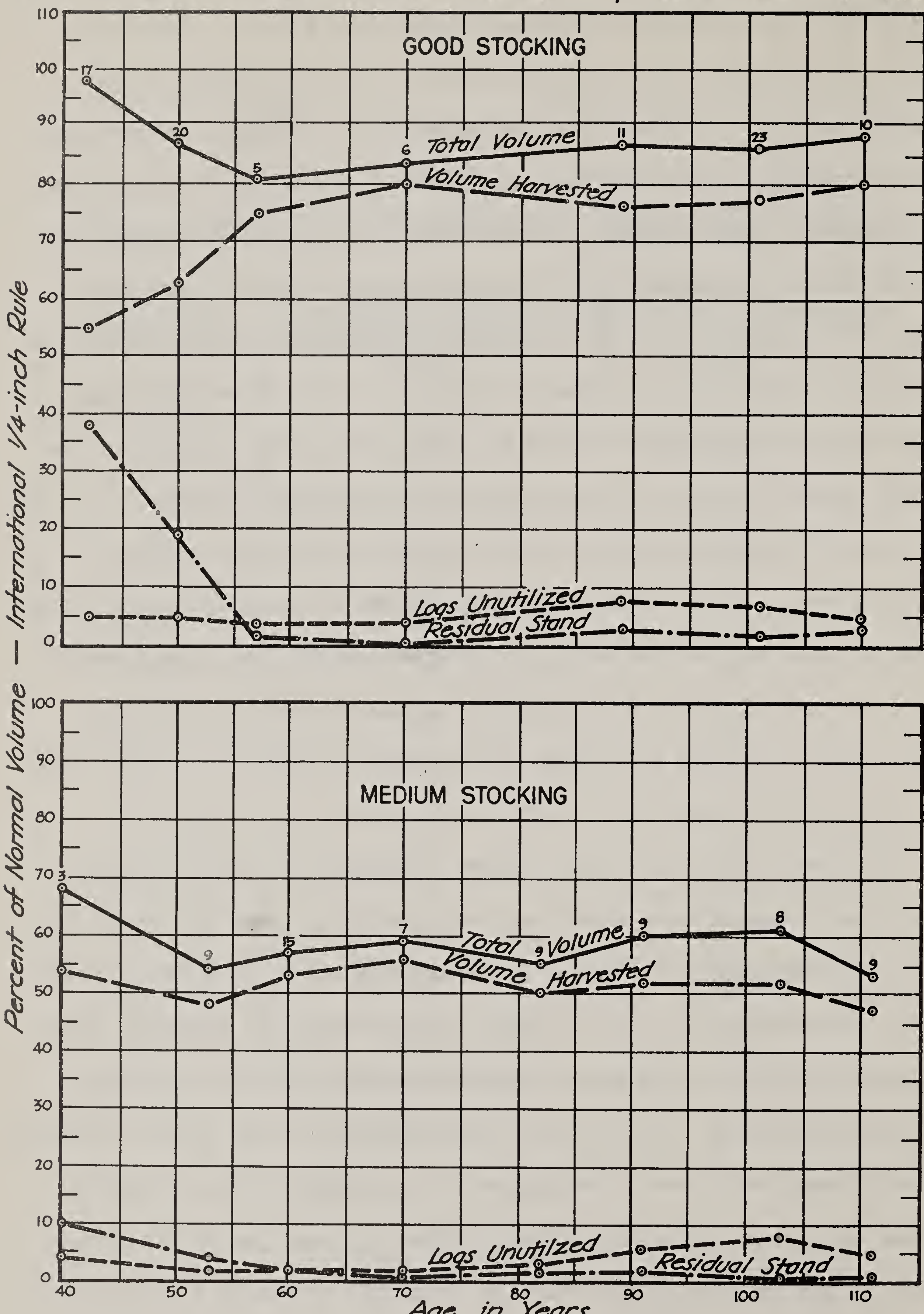
Table 2.--The relation of measured to normal saw-timber growth

| Age period (years) | Measured growth in terms of normal | |
|---|---|---|
| | Well-stocked areas | Medium-stocked areas |
| | Percent | Percent |
| 30-40 | 115 | 103 |
| 40-50 | 105 | 87 |
| 50-60 | 97 | 79 |
| 60-70 | 92 | 72 |
| 70-80 | 87 | 68 |
| 80-90 | 83 | 65 |
| 90-100 | 79 | 63 |
| 100-110 | 76 | 61 |
| 110-120 | 74 | 60 |
| 120-130 | 72 | 59 |
| 130-140 | 70 | 59 |
| 140-150 | 68 | 58 |
| 150-160 | 67 | 58 |

The normal yield table provides a convenient method for estimating the yield at harvest time for young stands, and also the future productivity of areas to be seeded or planted. For the latter, site quality must be estimated from the remnants of a former stand or from a nearby stand on similar site. A systematic yield table application study must be made, however, before estimates of yield at harvest far in the future can be made with any satisfactory degree of confidence. Results of such a survey on extensive second-growth logging operations in western Washington are given in figure 1. This shows that areas well stocked with Douglas-fir (i.e., having 70 percent or more of the normal number of trees for the average tree diameter) yielded in volume of harvest 75 to 80 percent of normal yield table volumes at ages of 60 to 110 years. If the total board-foot volume in the stands studied had been utilized the harvest at 60 to 110 years would have ranged from 80 to 88 percent of normal for the sites and ages sampled. Such practical checks as these are needed if the forest manager is to take some of the guesswork out of yield table application.

The lower chart in figure 1 shows volumes, in terms of normal, that were recovered from areas that were medium stocked (40 to 69 percent of normal number of trees for the average d.b.h.) at time of harvest. If harvest had been postponed on the areas that supported young stands it is likely that some of these would have in time moved into the "good-stocking" class. Thus, when estimating final yield of medium-stocked areas which are to be logged in the distant future, present volume should be measured by timber cruise and then the growth anticipated in the decades ahead should be estimated by applying successively the appropriate growth factors given in table 2.

FIGURE I. PERCENT OF NORMAL VOLUME FOUND ON SITE I, II AND III DOUGLAS-FIR LANDS



Estimating Gross Growth and Mortality. The conventional yield table shows only the volume in surviving trees at different ages. It does not show the total volume of wood produced and the volume lost by tree mortality. As intensiveness of management increases it is good business for the forester to know the total growth and the loss occurring in his various stands. A measure of these can be obtained in a yield table application study made by using either temporary or permanent plot techniques. Result of such a study on well-stocked Douglas-fir areas is summarized in table 3. Rate of loss in merchantable-sized trees was found to mount rapidly after 70 years of age. By 100 to 110 years, mortality averaged more than one-third of the normal rate of growth.

By such a yield table application study the trend of growth and mortality in typical stands can be computed by applying the values such as those in table 2 and in table 3 to the normal yield table growth rates. Result of this procedure for site II Douglas-fir lands is given in table 4.

The rate of annual growth, both gross and net, was found to be at the maximum about 1,620 board feet per acre, at age of 45 years. At this age the difference between gross and net growth is very small, owing to the low level of mortality. But as age advances and mortality increases, the spread between gross and net growth becomes much broader. For example, at 125 years, when gross growth is about 760 board feet per acre, net growth has fallen to 425 board feet. In other words, 44 percent of gross growth is being nullified by mortality.

Table 3.--Mortality as percent of normal saw-timber growth is strongly related to age (well-stocked areas)

| Age period (years) | Mortality as percent of normal saw-timber growth rate |
|---|---|
| | Percent |
| 30-40 | -- |
| 40-50 | .65 |
| 50-60 | 1.6 |
| 60-70 | 3.5 |
| 70-80 | 5.9 |
| 80-90 | 13.1 |
| 90-100 | 22.9 |
| 100-110 | 34.8 |
| 110-120 | 46.3 |
| 120-130 | 56.8 |
| 130-140 | 67.0 |
| 140-150 | 76.3 |
| 150-160 | 85.6 |

Table 4.--Trend of annual saw-timber growth and mortality on well-stocked Douglas-fir lands, site II, and comparison with normal growth

| Age period (years) | Measured periodic annual growth and mortality | | | Normal periodic annual growth | Measured net growth as % of normal |
|---|---|---|---|---|---|
| | Gross growth | Mortality | Net growth | | |
| | Bd. ft. | Bd. ft. | Bd. ft. | Bd. ft. | Pct. |
| 30-40 | 1,070 | -- | 1,070 | 930 | 115 |
| 40-50 | 1,630 | 10 | 1,620 | 1,540 | 105 |
| 50-60 | 1,525 | 25 | 1,500 | 1,550 | 97 |
| 60-70 | 1,375 | 50 | 1,325 | 1,440 | 92 |
| 70-80 | 1,190 | 75 | 1,115 | 1,280 | 87 |
| 80-90 | 1,065 | 145 | 920 | 1,105 | 83 |
| 90-100 | 960 | 215 | 745 | 940 | 79 |
| 100-110 | 875 | 275 | 600 | 790 | 76 |
| 110-120 | 820 | 315 | 505 | 680 | 74 |
| 120-130 | 760 | 335 | 425 | 590 | 72 |
| 130-140 | 725 | 355 | 370 | 530 | 70 |
| 140-150 | 700 | 370 | 330 | 485 | 68 |
| 150-160 | 685 | 385 | 300 | 450 | 67 |

Another use for normal yield tables is as an indicator of the most efficient rotation over which to grow even-aged stands. As shown in the last column of table 1 this is at about 100 years for site II. Yield table application studies on both permanent and temporary plots, however, have shown that actual untended stands reach their age of maximum mean annual increment about 10 to 20 years earlier than indicated by the normal yield tables.

Problems in the Use of Yield Tables

As all foresters know, many stands, in fact most stands, depart rather widely from theoretical yield table standards. The wider the departure of a given stand from the normal, the less satisfactory does the normal yield table serve as a medium for making growth estimates.

Change in Stand Normality. Numerous studies have shown that actual stands do change in normality as they grow older. Failure to allow for this leads to errors of conservatism for young stands, but may lead to overestimates of increment in second growth of advanced age. Proper allowance for change in normality can only be made by special supplementary study on permanent or temporary plots for each type and yield table. Adequate information of this kind is available for few of the forest types of the country.

Effect of Cutting on Growth. American yield tables do not make allowance for effect of intermediate cutting on growth. Partial allowance can be made by making indicated adjustments for change in normality and for the utilization of timber normally lost by mortality, but indications are that such adjustment is inadequate. Cutting may either increase or decrease growth, depending on the quality of forestry that is practiced in the operation.

Uneven-aged Stands. Several special yield tables have been prepared for estimating growth in uneven-aged stands, apparently with fairly good results--for example, in the northern hardwood type in the Lake States and in ponderosa pine in the Pacific Northwest. These are quite different in form, however, from the usual normal yield table. As a general principle, stand increment has been found to be estimated with less accuracy by techniques that predict future volumes than by those which predict annual growth directly.

Mixed Species. This is usually a source of headaches for the forester trying to apply a normal yield table. It is difficult to obtain from yield tables an accurate estimate of total growth in mixed stands--still more difficult to obtain estimates of growth by species.

Mature and Overmature. Most yield tables ignore this problem entirely. Yet the assumption that growth and mortality are in balance in such stands is too arbitrary to express accurately the trends that are actually taking place.

Change in Site Index. The site curves upon which yield tables are based represent the average height-age relationship for all soil and climatic subdivisions sampled within the forest type universe. On average soil types, tree height growth is rapid in youth, leveling off gradually toward maturity. On some soils supporting the same type of forest, height growth may be normal at early ages but level off more rapidly later. Such a stand referenced against standard site curves would show an apparent change in site index. Resulting errors in growth estimate may not always be small or compensating.

## Special Types of Yield Tables

An alternative solution to some of the above problems is to use empirical yield tables. These are similar to normal tables, but are based on average degree of stocking instead of full stocking. Even so, if applied to any specific stand, adjustments must be made although the adjustment is likely to be smaller than in the case of normal tables. A common source of difficulty with empirical tables is correlation between stocking and age. If such a relationship exists in the stands sampled, empirical tables derived for them might be almost useless. A new method for construction of non-normal yield tables which has been applied to loblolly pine has a number of advantages, and it is recommended that this method be considered in the construction of any new tables. Plots may be taken by mechanical sampling over the entire forest type universe, specific provision being made for density and composition correction factors. Computations are laborious, however, and the tables themselves do not provide means for making adjustments for changes in normality, composition, or site.

A new type of yield table has recently been prepared for Douglas-fir based on average tree diameter and number of trees per acre instead of on site and age. The result is summarized in tables 5, 6, and 7. To apply to any given stand simply determine the number of trees per acre, their average diameter, and their average height. Assume, for example, a stand having 150 trees per acre averaging 16 inches in d.b.h. and 130 feet high. Table 5 indicates that the average tree in such a stand 123 feet high contains 296 board feet. Estimated volume of the average tree in the present stand is then:

Table 5.--Revised Douglas-fir yield table
Based on average diameter instead
of site and age

| Av. d.b.h.1/ of stand (in.) | Normal number2/ of trees per acre | Normal ht. of trees of average d.b.h. | Volume in cubic feet per tree: Entire trees & total stand | Volume in cubic feet per tree: Vol. to 4" top in trees 5" + | Volume in cubic feet per tree: Vol. to 4" top in trees 7" + | Volume in cubic feet per tree: Vol. to 4" top in trees 12" + | Vol. in bd. ft. per tree, of trees 12" +: Intern. 1/8"3/ | Vol. in bd. ft. per tree, of trees 12" +: Scribner4/ |
|---|---|---|---|---|---|---|---|---|
| | | Ft. | | | | | | |
| 2 | 4,466 | 22 | | | | | | |
| 3 | 2,387 | 31 | | | | | | |
| 4 | 1,530 | 39 | 1.8 | 0.9 | 0.2 | | | |
| 5 | 1,084 | 47 | 3.2 | 2.1 | 1.1 | | | |
| 6 | 818 | 55 | 5.1 | 3.8 | 2.6 | 0.3 | | |
| 7 | 644 | 62 | 7.6 | 6.2 | 4.9 | 1.1 | 5 | 3 |
| 8 | 524 | 69 | 10.9 | 9.4 | 8.0 | 2.5 | 18 | 11 |
| 9 | 437 | 76 | 14.9 | 13.4 | 12.1 | 5.3 | 35 | 23 |
| 10 | 371 | 83 | 19.6 | 18.0 | 16.7 | 9.5 | 66 | 43 |
| 11 | 320 | 90 | 25.2 | 23.6 | 22.7 | 15.1 | 102 | 67 |
| 12 | 280 | 97 | 31.5 | 29.8 | 29.3 | 21.7 | 148 | 99 |
| 13 | 248 | 104 | 38.5 | 36.6 | 36.5 | 29.5 | 224 | 149 |
| 14 | 221 | 110 | 46.6 | 44.3 | 44.3 | 38.3 | 274 | 184 |
| 15 | 198 | 117 | 55.5 | 52.8 | 52.8 | 48.0 | 347 | 236 |
| 16 | 180 | 123 | 65 | 62 | 62 | 58 | 432 | 296 |
| 17 | 164 | 130 | 76 | 72 | 72 | 69 | 521 | 359 |
| 18 | 150 | 135 | 87 | 83 | 83 | 81 | 618 | 429 |
| 19 | 138 | 141 | 99 | 95 | 95 | 93 | 724 | 510 |
| 20 | 127 | 147 | 112 | 108 | 108 | 106 | 836 | 593 |
| 21 | 118 | 152 | 126 | 121 | 121 | 119 | 956 | 683 |
| 22 | 110 | 157 | 142 | 136 | 136 | 134 | 1,075 | 779 |
| 23 | 102 | 162 | 158 | 152 | 152 | 150 | 1,205 | 886 |
| 24 | 96 | 167 | 175 | 169 | 169 | 168 | 1,339 | 999 |
| 25 | 91 | 171 | 193 | 186 | 186 | 185 | 1,485 | 1,125 |
| 26 | 85 | 176 | 213 | 205 | 205 | 204 | 1,653 | 1,262 |
| 27 | 80 | 180 | 234 | 227 | 227 | 227 | 1,826 | 1,405 |
| 28 | 76 | 185 | 256 | 249 | 249 | 249 | 2,031 | 1,562 |
| 29 | 72 | 189 | 279 | 271 | 271 | 271 | 2,249 | 1,730 |
| 30 | 68 | 194 | 302 | 293 | 293 | 293 | 2,476 | 1,905 |

1/ Weighted by basal area.
2/ Total stand, i.e., trees over 1.5 inches in d.b.h.
3/ To 5-inch top.
4/ To 8-inch top.

Table 6.--Estimated diameter growth per decade in normal stands of second-growth Douglas-fir[1]

| Av. d.b.h. of stand (in.) | Diameter growth when age of stand in years is -- | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
| | Inches | | | | | | | | | | | | | |
| 2 | 1.6 | 1.1 | | | | | | | | | | | | |
| 3 | 2.0 | 1.4 | 0.9 | | | | | | | | | | | |
| 4 | 2.4 | 1.6 | 1.1 | 0.9 | | | | | | | | | | |
| 5 | 2.8 | 1.9 | 1.4 | 1.1 | | | | | | | | | | |
| 6 | 3.2 | 2.2 | 1.6 | 1.3 | 1.0 | | | | | | | | | |
| 7 | 3.7 | 2.5 | 1.8 | 1.4 | 1.1 | 0.8 | | | | | | | | |
| 8 | | 2.7 | 2.1 | 1.6 | 1.3 | 1.0 | 0.7 | 0.6 | 0.6 | | | | | |
| 9 | | 3.0 | 2.3 | 1.8 | 1.4 | 1.1 | 0.8 | 0.7 | 0.6 | 0.6 | | | | |
| 10 | | 3.3 | 2.6 | 1.9 | 1.5 | 1.2 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 | 0.5 | | |
| 11 | | 3.6 | 2.8 | 2.1 | 1.7 | 1.3 | 1.0 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 | 0.4 | 0.4 |
| 12 | | | 3.0 | 2.3 | 1.8 | 1.4 | 1.1 | 0.9 | 0.8 | 0.7 | 0.6 | 0.6 | 0.5 | 0.4 |
| 13 | | | 3.3 | 2.5 | 2.0 | 1.5 | 1.2 | 1.0 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 | 0.5 |
| 14 | | | 3.5 | 2.6 | 2.1 | 1.6 | 1.3 | 1.1 | 1.0 | 0.8 | 0.7 | 0.7 | 0.6 | 0.5 |
| 15 | | | 3.7 | 2.8 | 2.2 | 1.8 | 1.4 | 1.2 | 1.0 | 0.9 | 0.8 | 0.7 | 0.6 | 0.6 |
| 16 | | | 4.0 | 3.0 | 2.4 | 1.9 | 1.5 | 1.3 | 1.1 | 1.0 | 0.8 | 0.7 | 0.7 | 0.6 |
| 17 | | | | 3.1 | 2.5 | 2.0 | 1.6 | 1.3 | 1.2 | 1.0 | 0.9 | 0.8 | 0.7 | 0.7 |
| 18 | | | | 3.3 | 2.7 | 2.1 | 1.7 | 1.4 | 1.2 | 1.1 | 0.9 | 0.8 | 0.7 | 0.7 |
| 19 | | | | | 2.8 | 2.2 | 1.8 | 1.5 | 1.3 | 1.1 | 1.0 | 0.9 | 0.8 | 0.7 |
| 20 | | | | | 3.0 | 2.3 | 1.9 | 1.6 | 1.4 | 1.2 | 1.0 | 0.9 | 0.8 | 0.8 |
| 21 | | | | | 3.1 | 2.4 | 2.0 | 1.7 | 1.5 | 1.3 | 1.1 | 1.0 | 0.9 | 0.8 |
| 22 | | | | | | 2.5 | 2.1 | 1.7 | 1.5 | 1.3 | 1.1 | 1.0 | 0.9 | 0.8 |
| 23 | | | | | | 2.7 | 2.2 | 1.8 | 1.6 | 1.4 | 1.2 | 1.1 | 1.0 | 0.9 |
| 24 | | | | | | 2.8 | 2.3 | 1.9 | 1.7 | 1.4 | 1.2 | 1.1 | 1.0 | 0.9 |
| 25 | | | | | | 2.9 | 2.4 | 2.0 | 1.7 | 1.5 | 1.3 | 1.1 | 1.0 | 1.0 |
| 26 | | | | | | | 2.5 | 2.1 | 1.8 | 1.5 | 1.3 | 1.2 | 1.1 | 1.0 |
| 27 | | | | | | | 2.6 | 2.1 | 1.9 | 1.6 | 1.4 | 1.2 | 1.1 | 1.1 |
| 28 | | | | | | | 2.7 | 2.2 | 1.9 | 1.7 | 1.5 | 1.3 | 1.2 | 1.1 |
| 29 | | | | | | | | 2.3 | 2.0 | 1.7 | 1.5 | 1.3 | 1.2 | 1.1 |
| 30 | | | | | | | | 2.4 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.2 |

1/ The above figures are derived from McArdle's "Yield Tables" U. S. Dept. Agric. Tech. Bul. 201. Above figures include "false growth" resulting from death of smaller trees and hence will not agree with actual diameter growth of surviving trees as determined by borings.

Table 7.--Estimated increase in normality in a 10-year period

| Normality | 10 years' increase in normality | Normality after 10 years |
|---|---|---|
| .30 | .08 | .38 |
| .35 | .07 | .42 |
| .40 | .07 | .47 |
| .45 | .06 | .51 |
| .50 | .06 | .56 |
| .55 | .06 | .61 |
| .60 | .05 | .65 |
| .65 | .05 | .70 |
| .70 | .04 | .74 |
| .75 | .04 | .79 |
| .80 | .03 | .83 |
| .85 | .03 | .88 |
| .90 | .02 | .92 |
| .95 | .02 | .97 |
| 1.00 | .02 | 1.02 |
| 1.05 | .01 | 1.06 |
| 1.10 | .01 | 1.11 |
| 1.15 | .00 | 1.15 |
| 1.20 | .00 | 1.20 |
| 1.25 | .00 | 1.25 |
| 1.30 | -.01 | 1.29 |
| 1.35 | -.01 | 1.34 |
| 1.40 | -.02 | 1.38 |
| 1.45 | -.02 | 1.43 |
| 1.50 | -.03 | 1.47 |

$$296 \times \frac{130}{123} = 313 \text{ board feet, Scribner rule}$$

Present volume of the stand is then estimated as volume of average tree times number of trees per acre, or:

$$313 \times 150 = 46{,}950 \text{ board feet per acre}$$

Present normality of the stand $= \frac{150}{180} = 83$ percent

To estimate volume 10 years hence:

Assume, for example, present stand age is 50 years.

Table 6 indicates a stand averaging 16 inches in d.b.h. and 50 years in age will increase in average d.b.h. by 3 inches over the next 10 years, or to 19 inches.

Table 7 indicates that a stand presently 83 percent of normal will increase to 86 percent within 10 years.

Refer again to table 5 and read average volume per tree for a stand averaging 19 inches in d.b.h. = 510 board feet.

Corrected for present excess of measured over normal height this becomes:

$$510 \times \frac{130}{123} = 539 \text{ board feet per tree}$$

Estimated number of trees per acre 10 years hence is normal number of trees for a stand averaging 19 inches in d.b.h. times estimated normality 10 years hence, or:

$$138 \times .86 = 119$$

And estimated total volume 10 years hence amounts to volume of average tree 10 years hence times number of trees per acre 10 years hence, or:

$$539 \text{ board feet} \times 119 = 64{,}141 \text{ board feet per acre}$$

Estimated annual growth per acre for the next decade equals future volume less present volume divided by years in the period, or:

$$\frac{64{,}141 - 46{,}950}{10} = 1{,}719 \text{ board feet}$$

<u>What is the Future of Yield Tables</u>

Within a third of a century of technical effort American foresters have constructed yield tables of one sort or another for most of the important pure, even-aged types in the United States. A few have been constructed for mixed and uneven-aged stands. There is a wide range in the technical adequacy of these tables. Some are useful, some are clearly inadequate, some are insufficiently tested to judge their worth. Adequate application studies have been completed on few, if any. Is the task of making the necessary application studies, modifications, or new tables justified? The answer will vary region by region and type by type.

For second-growth forests which are mostly even-aged and comparatively in pure stands or in simple species combinations, a standard yield table can be prepared or adapted for estimating growth, mortality, and final yield with appropriate efficiency and accuracy. For estimating the periodic growth of such stands, either past or far into the future, or for appraising for stands managed under a one-harvest-cut-per-rotation system the potential growth and the volume of growing stock required to attain it, yield tables are a valuable working tool for the forest manager, particularly in the pioneering stages of management.

Over much of the west, topography or other factors prevent the making of thinnings or intermediate cuts. Thus, for the foreseeable future the manager of such forest areas is likely to be limited to one harvest cut per rotation and his forest is likely to be generally evenaged and perhaps simple in composition. Estimates of yields far into the future will be needed in regulating the cut and yield table techniques are likely to be of continuing utility in providing such estimates.

For stands that are prevailingly unevenaged, composed of complicated species mixtures, and likely to be cut many times during a rotation, adequate growth estimates usually can be obtained far more readily by stand table projection or by permanent plots than by yield table methods. Permanent plots serve effectively to determine by direct measurement the trends of growth and mortality. In addition, permanent or semi-permanent plots can provide the basic data for the development of detailed growth and mortality probability tables for various tree sizes, species, age, and vigor classes. Such probability tables should be increasingly useful as management becomes more intensive.

There is a specialized type of yield table, however, that is likely to find a place in connection with some of the most intensive management we can imagine. Such a yield schedule for a Douglas-fir plantation in Denmark is given in table 8. The detailed record begins at 26 years, but previous thinnings had removed 2,200.9 cubic feet per acre. Thinnings continued at intervals of several years and at age 57 years mean annual yield amounted to 331.5 cubic feet per acre. This is 2-1/5 times the increment indicated by the normal yield tables for full natural stands of this age and site. Also impressive is the average diameter of 18.5 inches for site III, 57 years, in contrast to 11 inches for normal Douglas-fir of similar age and site.

Table 8.--Life history of Douglas-fir plantation in Denmark[1]

(Values on an acre basis)

| Stand statistics | 26 yrs. Autumn 1907 | 29 yrs. Autumn 1910 | 32 yrs. Autumn 1913 | 36 yrs. Autumn 1917 | 41 yrs. Autumn 1922 | 44 yrs. Spring 1926 | 46½ yrs. Summer 1928 | 48 yrs. Spring 1930 | 53 yrs. Autumn 1934 | 57 yrs. Autumn 1938 |
|---|---|---|---|---|---|---|---|---|---|---|
| **After thinning** | | | | | | | | | | |
| No. of stems | 618 | 457 | 364 | 265 | 226 | 189 | 153 | 130 | 102 | 76 |
| D.b.h. (inches) | 6.7 | 7.7 | 8.9 | 10.2 | 11.9 | 12.9 | 14.0 | 14.7 | 16.6 | 18.5 |
| Height (feet) | 51.2 | 57.7 | 63.3 | 70.2 | 77.7 | 82.0 | 85.3 | 86.9 | 91.8 | 95.1 |
| Volume (cu. ft.) | 3,958.7 | 4,273.1 | 4,830.5 | 4,973.4 | 6,245.3 | 6,388.2 | 6,283.2 | 5,930.9 | 6,159.6 | 5,873.7 |
| **Removed in thinning** | | | | | | | | | | |
| No. of stems | 226 | 161 | 93 | 99 | 39 | 37 | 36 | 23 | 28 | 26 |
| D.b.h. (inches) | 5.5 | 6.4 | 7.7 | 9.4 | 10.9 | 10.8 | 12.5 | 13.6 | 14.8 | 15.4 |
| Height (feet) | 48.9 | 55.1 | 61.7 | 69.5 | 80.7 | 80.7 | 85.0 | 87.9 | 91.2 | 92.8 |
| Volume (cu. ft.) | 928.9 | 1,000.4 | 886.1 | 1,486.3 | 928.9 | 828.9 | 1,171.9 | 871.8 | 1,386.3 | 1,329.1 |
| **Before thinning** | | | | | | | | | | |
| No. of stems | 844 | 618 | 457 | 364 | 265 | 226 | 189 | 153 | 130 | 102 |
| D.b.h. (inches) | 6.4 | 7.4 | 8.7 | 10.0 | 11.7 | 12.6 | 13.7 | 14.5 | 16.2 | 17.8 |
| Height (feet) | 50.5 | 57.1 | 63.0 | 70.2 | 78.4 | 81.7 | 85.3 | 87.3 | 91.8 | 94.8 |
| Volume (cu. ft.) | 4,887.6 | 5,273.5 | 5,716.6 | 6,459.7 | 7,174.2 | 7,217.1 | 7,460.1 | 6,802.7 | 7,545.9 | 7,202.8 |
| **Periodic annual increment** | | | | | | | | | | |
| D.b.h. (inches) | | .23 | .33 | .28 | .30 | .23 | .32 | .33 | .30 | .30 |
| Height (feet) | | 2.0 | 1.8 | 1.7 | 1.6 | 1.3 | 1.3 | 1.3 | 1.0 | .8 |
| Volume (cu. ft.) | | 438.3 | 481.1 | 407.3 | 440.2 | 323.9 | 428.8 | 343.0 | 323.0 | 260.8 |
| Mean annual yield (cu. ft.) | 272.6 | 289.8 | 307.7 | 318.8 | 333.6 | 332.9 | 338.1 | 338.2 | 336.8 | 331.5 |

1/ From unpublished yield tables for Douglas-fir plantations in Denmark. Basic data supplied by O. Marstrand Jørgensen, Langesoe, Denmark, translated to British units by Pacific Northwest Forest and Range Experiment Station.

As possibilities for intensive management develop in this country it is likely that some such form of yield table will find a place in guiding the foresters who direct the harvest.

March 25, 1949

# THE PREDICTION OF GROWTH BY STAND PROJECTION METHODS

P. R. Wheeler
Southern Forest Experiment Station
Forest Service, U. S. Department of Agriculture

The stand projection method is a device for projecting a particular stand forward to obtain an estimate of volume growth for an immediate, limited period in the life of that stand. Auxiliary studies or estimates are necessary to forecast mortality. Estimation of yield often involves a long period of time and other considerations that are beyond the scope of the stand projection method.

Stand projection involves moving a present stand table ahead for some given period by use of radial growth measurements. Volumes of the present and future stands are then obtained and compared to determine volume growth for the period. For stand projection, three things are required: the present stand table, radial growth measurements and volume tables. Each of these items is subject to sampling error. Also the methods available for the several calculations needed are subject to the necessity of making assumptions and using concepts that are far from hole-proof.

## Present Methods

The detailed use of stand projection as a growth prediction mechanism has been thoroughly described by W. G. Wahlenberg in USDA Technical Bulletin No. 796, "Methods of Forecasting Timber Growth in Irregular Stands." This publication, which probably has received far less use than it deserves, summarizes the procedure so well that I will base my discussion upon it.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

A stand table is obtained from a timber cruise. Radial growths are obtained from increment cores from some portion of the standing trees. Before radial growths can be used, one of two basic assumptions must be made. Growth of the trees in the stand during a future period may be assumed to be the same as it was in an immediately past period, or the assumption may be made "that trees of a given size class will increase in diameter.during the coming decade as rapidly as trees that were in this same size class a decade ago increased during the past decade." Neither assumption can be wholly true, but one or the other, or some modification must be made.

Both stand growth assumptions can only be approximations. To assume that all trees in a stand will necessarily grow in the next 10 years at the same rate as they have in the past 10 years is obviously faulty. Stand density and the weather, if nothing else, would see to that. To determine the rate at which trees of a given size class were growing 10 years ago involves considerable work. Unless proportionate sampling is carried back through several diameter classes, one finds himself with a dangling fraction of trees that moved one or more diameter classes and an unknown fraction of trees that remained behind. Density, weather, site, and stand condition are factors which make it almost impossible for the end result to depict what occurs in nature.

Three concepts of growth movement are available: (1) that all trees of a given size class will grow at the average rate for that class, (2) that an approximation of the dispersion of growth rates within a size class can be made from the average rate for the class, or (3) that from an adequate sample the variation of growth rates within a diameter

class can be determined which will portray growth movement. No one of these concepts is recommended as universally suitable.

The decision to use one of the three growth-movement concepts will depend to some extent on the amount of radial growth data available and on the character of the stand. If one has but few measurements, the use of averages is necessary. Harmonized curves or regressions showing the dispersion of growth rates within diameter classes require more radial growth data than are usually obtained in a timber cruise.

If a stand is composed entirely of merchantable, sawlog-size trees, the major error one is apt to encounter in the use of average radial growths is that caused by considering the curve of a tree diameter-volume table to be a straight line for the segment of average diameter growth. This error results in a consistent overestimation of volume growth, but may be inconsequential, particularly in the upper diameters where the usual "volume over tree diameter" curve closely approaches a straight line.

Where a stand includes many undersawlog-size trees, as do most of our second-growth southern pine stands, ingrowth from below across the minimum sawlog-size limit becomes of considerable magnitude. It is here that use of either of the first two growth movement concepts can cause serious trouble. An average growth applied to one of the under-sawlog-size diameter classes may indicate that no trees of the class will become sawlog size in the period of prediction. Growth dispersions more nearly show what is going on in a stand where some trees of 2, 3, or even 4 diameter classes below the sawlog-size limit may cross the line within a decade and increase in volume from zero board feet to a

finite quantity. One difficulty with the dispersion method is that increment cores from eccentric trees exaggerate these movements and failures to move into sawlog size. Where ingrowth is heavy, the composite effect of these exaggerations is considered to be a less serious error than the possibility of greatly underestimating ingrowth.

Wahlenberg continues by describing the "17 numerical steps" in the projection of a stand table. The job is tedious and drawn out but not difficult. For an illustration, he chose to set the trees back 5 years to find what they grew on the average during the period, taking bark growth into account. An estimate of mortality was injected and an estimate of periodic volume growth in board feet obtained. By this method, periodic annual volume growth estimates were calculated for several natural and old field pine stand conditions found on the Crossett Experimental Forest. The results serve to illustrate the variations to be expected in annual volume growths and growth rates of similar pine stands, particularly the proportion ingrowth may bear to total periodic growth. In these stands, the latter proportion varied from 13 or 14 percent in light pine and mixed pine-hardwood stands to 34 percent in two-storied pine stands. For southern Arkansas as a whole, the Forest Survey in 1935 found that one-third of total pine board foot volume growth came from ingrowth.

Wahlenberg also points out the advisability of avoiding unnecessary detail; growth deceleration and acceleration as sources of error, together with other possible sources of error; puts in a plug for the recurring or continuous inventory method; and winds up with a discussion of the application of growth forecasts in forest management. If one has any

idea of using the stand projection method, the bulletin will repay careful study, as will the very complete bibliography which includes all pertinent literature to 1941.

Only a few significant publications have appeared since 1941. In 1942, H. A. Meyer wrote "Methods of Forest Growth Determination," Bulletin 435 of the School of Agriculture Experiment Station of Pennsylvania State College. It is quite technical in nature and includes many statistical derivations of common formulae. Much of it parallels Wahlenberg's methodologies and discussions. Meyer's work is chiefly valuable to the non-specialist for his exposition of climatic fluctuations in making comparisons of periodic increment. He lists some experimental results from the South which indicate that weather may cause timber growth to fluctuate from 17 to over 40 percent.

S. R. Gevorkiantz and L. P. Olsen have described "An Improved Increment-core Method for Predicting Growth of Forest Stands," in Lake States Forest Experiment Station Paper No. 12, 1948. The technics outlined will have the most application when age classes and the relation of local form class to that of Lake States timber are known. The authors present a rule-of-thumb for estimating the number of borings needed. To obtain a standard error of volume growth of approximately 10 percent for a stand, about 225 borings are required, distributed through the diameter classes in the proportion their volumes bear to the total volume.

It is helpful to consider briefly the part stand characteristics play in the prediction of stand growth. W. A. Duerr and S. R. Gevorkiantz

developed regressions for "Growth Prediction and Site Determination in Uneven-Aged Timber Stands," 1938, Journal of Agricultural Research 56: 2, 81-98. Their work is also described in Lake States Forest Experiment Station Economic Notes No. 9, "Methods of Predicting Growth of Forest Stands." Main stand age, density, site, and the proportion of merchantable to unmerchantable size trees in the stand were expressed as a series of relationships to growth. In order to use the simplified growth tables for average sites which the authors present in the latter publication, only the total board foot volume of the sawlog-size trees, the basal area of all trees (1" d.b.h. and larger), and the stand age need be known. Board foot volume varies rather directly with age in each forest type, so that a reasonable modification might be to express growth only in relation to board foot volume and total basal area. Basal area is not often obtained in a general timber cruise, but it is usually necessary to make some estimate of cordwood volume of the trees under sawlog size down to a lower pulpwood limit. If the board foot volume of a stand is converted to cordwood volume and the volume of undersawlog-size trees added, the total cordwood volume of trees 5.0" and larger can be used as a basic factor comparable to total basal area. From an ordinary timber cruise, then, we might readily obtain two important items necessary to describe the characteristics of the stand required for the purpose of estimating growth: board foot volume and total cordwood volume. The possible use of these stand characteristics and their relationship to growth percent is discussed later.

One possibility sometimes considered is that of reconstructing a stand at a given time in the immediate past for comparison with the present stand. The difference obtained should be net volume growth, but

the inability to reconstruct the past stand with respect to number of trees becomes insurmountable. There can be no way of precisely determining the missing trees. True, a few may be still standing and others on the ground, but an unknown number have rotted away or have been removed for use. The dead trees present may have died either before or after the point in time set as a reference. Little less difficult are determinations of past height, past form and past defect. Eccentricities of cross section, faulty ring counts, and bark determinations make accurate determination of past diameter difficult, though not completely impossible of attainment. The whole idea of stand reconstruction is best termed involved and ineffective.

## Proposed Method

If one is faced with using stand projection, it has appealed to me that the best approximation of growth might be obtained by estimating future radial growths in the field. While one is at the tree with the increment core record for the past 5 and 10 year periods in hand, then would be the time to size up the tree in relation to its associates and planned removals. If the past growth indicated deceleration and no surrounding trees were marked for cutting, it would be relatively easy to estimate a continuing deceleration. Conversely, if the tree was booming along and to be given release, the acceleration might well continue. The tough ones to estimate would be slow-growing trees about to be released. How much release should be estimated? We still need further research to answer that with any degree of assurance, but an estimate based on experience should be far better than making some of the assumptions of stand movement we have discussed.

Having recorded estimated future radial or diameter growths, the only correction required would be for bark growth. Work at the Southern Station and elsewhere indicates that for pine and upland hardwoods, bark growth is about 10 percent of wood growth; for Delta hardwoods it is about 5 percent of wood growth. The respective wood and bark growth factors in terms of wood growth are 1.10 and 1.05.

The assumption that a local diameter-volume table obtained 5 or 10 years later will be the same as that at present may be faulty because of possible form and height changes. But except in extreme cases the differences between the present and future local volume over d.b.h. curves are apt to be more in the nature of differences in level rather than of slope. Volume changes with increase in diameter, then, are likely to be nearly the same whichever curve they are read from. Volume determination for ingrowth is an exception, though probably not serious in most cases.

Instead of preparing dispersion curves to determine class movement, volume growth for each sample tree might be determined. Fewer sample trees would be required, for not as many samples should be needed to measure average volume growth adequately as to prepare strong dispersion curves. From a local diameter-volume table, the volume growth associated with one inch of wood and bark growth at the mid-point of each diameter class can be determined. From these, the volume growths of each sample tree can be calculated and the results totaled. The total can be expanded to gross growth for the entire stand, or it may be related to the present volume of the samples to determine a gross growth percent for application to stand volume. To approximate net growth, some estimate of mortality, as in any method, is required.

Though not field-tested, the assumptions proposed that future radial growths can be estimated in the field better than in the office, and that local diameter-volume tables will not materially change during a 10-year period, cannot be open to serious question. With very little additional field work, we can improve growth prediction and eliminate unnecessary computations. The required intensity of presentative sampling should not exceed that suggested by Gevorkiantz, and probably fewer than 225 increment cores would be required in one stand.

## Forest Survey Growth Percents, A Substitute for Stand Projection

All systems of stand projection that have been discussed are subject to errors of greater or lesser magnitudes. After making many field measurements and going through a multitude of calculations, we still come out with results in which we seldom can have full confidence. This is particularly so when an improvement cut is to be made. How can we predict with any certainty how the stand is going to react after it has been opened up and poor risk trees removed?

Since the first step in forest management is generally an improvement cut, it would appear that the most sensible and efficient way to determine how the stand is going to react would be to establish permanent growth and mortality plots. If enough plots are established and reasonable records are kept, the only possible accurate measure of what is occurring to the stand will be obtained. The uncertainties are measurable sampling errors, and the full effect of release and removal of poor risk trees is learned.

But what to do for the intervening period? How can an estimate be readily made to serve the purposes of the management plan? What do

we know about the stands of a working circle or a region that will give us a usable estimate of growth and mortality? To find out, I've gone to the Forest Survey. Here in the South, during the period 1933 to 1936, over 100 million acres of timber land were cruised, and growth and mortality were measured and calculated. Without going into the detailed records, there are certain end figures available that describe the stands and show a relation to the growth percent.

The use of growth percent may be questioned, but certainly the thing that is most strongly correlated with volume growth is stand per acre. Unless there is a stand there is no growth, and most heavy stands will produce a large gross volume growth. Many of you, no doubt, have estimated that a stand of 1,000 board feet per acre is growing 50 board feet per acre per year, or a stand of 8,000 growing 400, 5 percent in each case. And one wouldn't be far wrong at any time in guessing at a reasonable growth percent and applying it to the stand volume.

However, we know that the character of the stand is going to cause the growth rate to vary. In an old-growth stand the growth percent is usually low, in a young stand it is apt to be high. As has been said, two components make up board foot volume growth, the growth of trees already of sawlog size and the ingrowth of trees from below sawlog size. In an old growth stand, the large trees approaching maturity have slowed in growth, and the proportion of small trees available for ingrowth is small. The converse is true of young stands. At the same time, given two stands of the same board foot volume per acre, one old, the other young, the younger stand with its higher proportion of small trees available for ingrowth is almost certain to have the higher volume

growth and consequently the higher board foot growth percent, unless by chance it is even-aged with all trees already of merchantable size.

The single factor that tells the most about the character of a stand and its ability to produce ingrowth is the relation of small-tree volume to large-tree volume. Small-tree and large-tree volumes are not always available as separate figures, but Forest Survey data are published presenting board foot volumes of large trees and cordwood volumes of small and large trees combined. These combined data are just as useful as separate figures. If all trees in a stand were of sawlog size and the volumes of the logs expressed both in cords and board feet, a ratio of about 2 cords per MBM would be expected. The inclusion of the cordwood volume of trees below sawlog size increases the cords per MBM ratio in relation to the proportion of the stand composed of undersawlog-size tree volume. Upper stem cordwood volume in pines, usable for pulp, slightly increases the ratio.

Board-foot and cordwood volumes per acre for the pine-hardwood region west of the Mississippi River have been issued as Forest Survey Release 26, copies of which are available for reference. These data, board-foot and cordwood volumes for the pine and hardwood species components, are presented for forest conditions, defined in the appendix to the Release. The cordwood volumes include trees of all sizes 5.0 inches d.b.h. and larger; the pine board-foot volumes include trees 9.0 inches d.b.h. and larger; and hardwood board-foot volumes, trees 13.0 inches d.b.h. and larger.

In the several average-acre tables attached, the cordwood and board-foot volumes per acre for each of the survey units in Southern

Station territory are shown. From these the "Cords/MBM ratios" have been calculated for the pine and hardwood species components. For pine, as well as for hardwoods, you will note throughout the several survey units the striking similarity of these ratios for the old-growth uncut condition, for the partly cut, and for the second-growth sawlog-size, uncut and partly cut conditions. More variability is found in the second-growth undersawlog-size reproduction and clear-cut conditions where the board foot base volumes are low and variable. The important thing is that the character of these stands is quite well described to the end that each condition becomes a separate entity. The ratios are low in the old-growth conditions; there are but few small trees available for ingrowth. The ratio increases in the second-growth conditions; more trees are available for ingrowth. Generally, as one would expect, the partly cut conditions have greater proportions of small trees than the uncut conditions.

How do these ratios help to predict growth? The general relation is evident in the table. In any Survey unit, as the cords/MBM ratios increase, the gross annual board-foot growth percents increase, not smoothly in all cases, but it looks as if we had something. To visualize the relationship more easily, the pine gross annual board-foot growth percents over the cds/MBM data have been plotted in figure 1. It's rather a jumble of points, but the trend is strong. There are inconsistencies which are not easily explained, but the relatively fast timber growing areas such as Texas 1, Louisiana 5, and Mississippi 3 are found on the upper side of the band. The slower growing, mountainous units are on the lower side. Arkansas 4, the unit the Ouachita National Forest

is in, is one of them. Alabama 5 and 6, the northern units of Arkansas, are others on the low side. Most of the rest are pretty well distributed in between. It is gratifying to note that for a given cords/MBM ratio the extreme range of the growth percents on either side of the central band is hardly more than 1 percent.

In figure 2, similar data have been plotted for the hardwoods of the Delta units. Though these data are fewer, the trend is apparent. The probable explanation for the slow growing position of Louisiana 2 is the presence of a considerable area of the slow growing cypress-tupelo type.

The trend lines indicated have not been calculated, but they are included to assist in showing the relationship between board foot growth percent and the cords/MBM ratio. One could use these trend lines to interpolate values for fast, medium, and slow-growing stands, but I feel that it would be safer to work only with the figures for the particular Survey Unit within which a working circle fell. Inconsistent though the figures may be for a particular unit, they portray the character of those stands and the sites on which they grow. There is little question in my mind that the cords/MBM ratio obtained from the cruise of a working circle, interpolated between those of the Survey Unit in question, will enable the approximation of a more valid growth percent than will any reasonable amount of increment core measurements and stand projection calculations.

The above statement is rather broad, but I make it because I have sweated out several thousands of sample tree radial growth measurements and many of the calculations upon which the Forest Survey growth percents

are based. They are the result of one method of stand projection, the best method that could be devised to fit field and office procedures at the time. The sample trees were observed in proportion to the total stand, so each sample tree was moved ahead 10 years by doubling the radial growth. Volume tables were applied and the volumes of the sample trees at present and 10 years hence were each totaled. The ratio of increase for the 10 year period was found, and from that the compound rate of gross annual growth was determined. To do this, three assumptions had to be made: (1) That the trees would grow as much in diameter in the next 10 years as they had in the past 10. (2) That the diameter-volume table would not change in 10 years. (3) That the sample tree growth rates determined represented the regional effect on growth of site, stand ages, density of stocking, species composition, crown form, and proportion of small trees. Bark growth was left out of the computations to balance elliptical measurement of radial growth and unknown factors of the three assumptions, in addition to what was hoped might insure a slightly conservative estimate of volume growth. When you stop to think of it, each of these assumptions is subject to many "ifs" and "ands". Only when one considers that current cutting practices have tended to keep the region's forests in the generally understocked condition of 12 to 16 years ago does it appear reasonable to assume that any great number of the trees in a stand will grow as fast, or as slow, the next 10 years as in the past. The volume table may not change radically, but certainly it is hardly a static thing as long as high-grading the taller, better formed individuals continues.

In using most any standard method of stand projection, one is faced with making very nearly the same assumptions. If one is willing

[illegible]

[illegible]

[illegible]

[illegible]

to make these, about the same results as those of the Forest Survey will be obtained. But, having based the work on such assumptions, how confident can one feel of the results? They are just another hat full of figures, a stage better than a good guess. It still seems reasonable to recommend the use of Forest Survey growth percents as not too far-fetched approximations, saving the field time and effort for the installation and remeasurement of permanent growth and mortality plots.

## Mortality Estimates

In any method of growth prediction, some estimate of mortality is required to enable the reduction of gross growth to net growth. Unfortunately, there is no tombstone that appears beside a tree at the time it dies with the date of death engraved upon it. There are some external indications of how long a tree has been dead, but season of year, species, age or size, and other factors all cause considerable variation. The Southern Forest Survey used the following criteria:

> "Recent Dead Trees, Standing or Down: Dead Pine trees which still retain their bark on more than 50 percent of the stem surface will be tallied .... by diameter regardless of whether the trees are standing or down.
>
> "Dead hardwood trees which still retain branches under 5 inches in diameter will be tallied....by diameter regardless of whether they are standing or down. Small dead standing trees that originally had no 5 inch limbs will be tallied unless their top is gone below the point where the stem is 5 inches in diameter. All dead trees

under 7 inches d.b.h. will be tallied whether standing or down regardless of the presence or absence of limbs. The only exception to this rule is in the case of down trees so badly decomposed that a kick breaks the stem into a loose pulpy mass of decomposed material. Dead trees of the scrub oak group will not be recorded."

Pines of all sizes with 50 percent of the bark remaining were considered to have died over a three-year period. Dead hardwoods were handled in three groups: trees 6 to 12 inches d.b.h. were considered to have died within 3 years; trees 14 to 20 inches, within 4-1/2 years; trees 22 inches and larger, within 6 years. The trees tallied as dead were given appropriate volumes and the sub-totals of each of the several diameter groups indicated were divided by the period of years over which the trees died to find the average annual mortality. The result expressed as a proportion of the live stand volume is annual mortality percent. These data have been tabulated in attached tables. The figures have some meaning, but it will be difficult to use them directly in management plans. The Survey data came from areas of several million acres which included every conceivable type of management and mismanagement. And certainly but few private owners go looking for poor risk trees to anticipate mortality. At the same time, these data can serve as a guide until accurate information can be obtained from permanent plots. And even if a figure such as 1 percent mortality per year should be pulled out of the air, the table shows that it might not be too badly off. It might be justified by some back-of-envelope

> [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

calculation thus--if a mature stand replaced itself in 100 years, about 1 percent of the total volume would fall out every year.

In general, second growth stands in a thrifty condition would be expected to have a smaller annual mortality percent. If 1 percent appears to be too high in consideration of the thrift of the stand or the anticipation of mortality by the removal of poor risk trees, some reasonable fraction, perhaps one-half or one-third of the Forest Survey estimate for the surrounding area, should satisfactorily approximate the need. Only auxiliary studies can determine mortality rates in understocked stands, or in stands following an improvement cut, and such studies can only produce results from permanent plots.

## Summary

It appears that the inherent weaknesses of the several stand projection methods available make them of little or only occasional use in the preparation of basic growth information upon which to build a management plan. This is particularly so in the first stage of forest management when an improvement cut is apt to make radical changes in the composition and density of the stands and in consequent growth and mortality rates. As an immediately available and reasonable substitue, the use of Forest Survey growth percents in relation to the stand-characterizing ratio--cords/MBM--is proposed. Mortality percents may be approximated, using available Forest Survey data as a guide. The suggestion is made that permanent growth and mortality plots be installed or some method of continuous inventory be used to determine more accurately the growth, mortality, and eventually the yield of individual working circles.

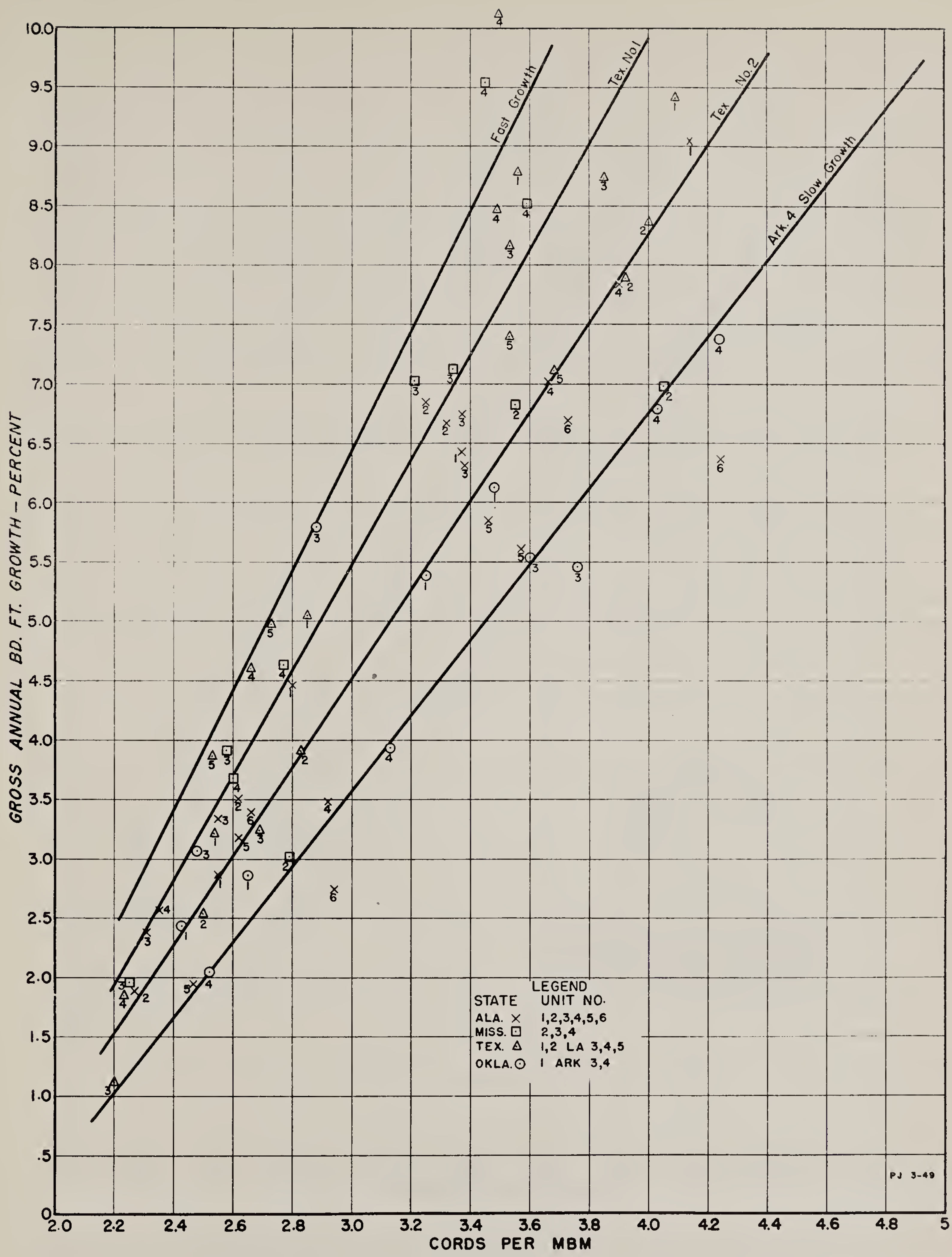



Figure 1.--Pine component--pine-hardwood and naval stores survey units, sawlog size conditions.

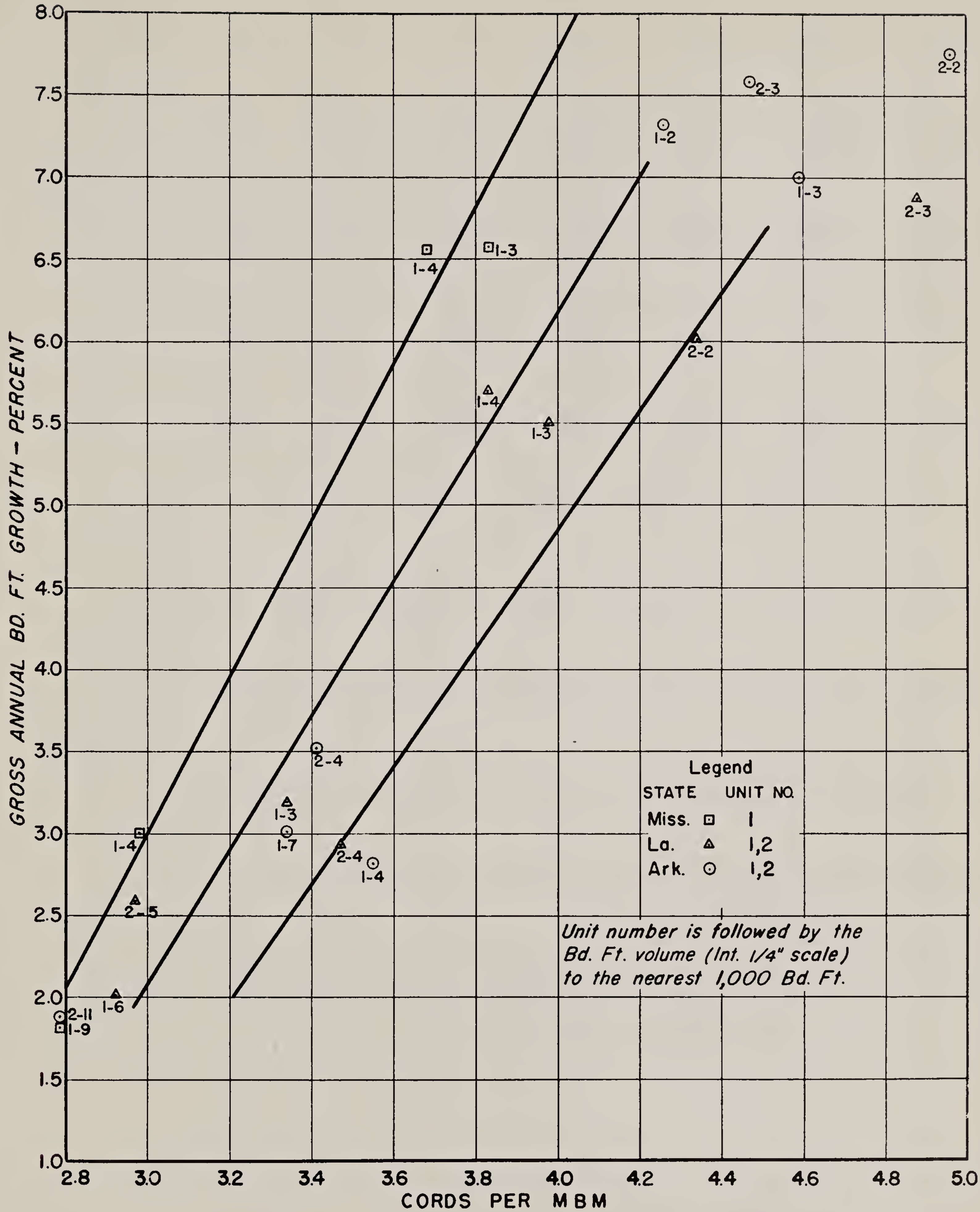



Figure 2.--Hardwood (including cypress and pine)--Delta survey units, sawlog size conditions.

March 10, 1949

AVERAGE ACRE VOLUMES
and
BOARD FOOT GROWTH PERCENTS
Pine-Hardwood West

*

| State | Unit | Pine | | | | | | Hardwood | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Old growth | | Second growth | | | Repro. | Old growth | | Second growth | | | Repro. | Old growth | | Second growth | | | Repro. |
| | | | | Sawlog | | Under | and | | | Sawlog | | Under | and | | | Sawlog | | Under | and |
| | | Uncut | Partly cut | Uncut | Partly cut | sawlog size | clear-cut | Uncut | Partly cut | Uncut | Partly cut | sawlog size | clear-cut | Uncut | Partly cut | Uncut | Partly cut | sawlog size | clear-cut |
| Texas 1 | Bd. ft. | 3,270 | 1,650 | 3,120 | 1,810 | 230 | 70 | 4,160 | 2,530 | 1,010 | 850 | 100 | - | 7,430 | 4,180 | 4,130 | 2,660 | 330 | 70 |
| | Cords | 8.3 | 4.7 | 11.1 | 7.4 | 2.0 | 0.3 | 14.6 | 9.7 | 5.6 | 4.7 | 1.7 | - | 22.9 | 14.4 | 16.7 | 12.1 | 3.7 | 0.3 |
| | Cds/MBM | 2.54 | 2.85 | 3.56 | 4.09 | 8.7 | 4.3 | 3.51 | 3.83 | 5.54 | 5.53 | 17.0 | - | | | | | | |
| | Bd.ft.Gr.%: | 3.22 | 5.05 | 8.78 | 9.41 | 39.73 | 9.66 | 3.27 | 3.83 | 5.38 | 5.99 | 14.99 | 11.14 | | | | | | |
| Texas 2 | Bd. ft. | 2,600 | 1,130 | 2,630 | 1,600 | 90 | 10 | 3,410 | 2,660 | 830 | 810 | 80 | - | 6,010 | 3,790 | 3,460 | 2,410 | 170 | 10 |
| | Cords | 6.5 | 3.2 | 10.3 | 6.4 | 1.2 | - | 11.5 | 9.6 | 5.2 | 4.8 | 2.4 | 0.1 | 18.0 | 12.8 | 15.5 | 11.2 | 3.6 | 0.1 |
| | Cds/MBM | 2.50 | 2.83 | 3.92 | 4.00 | 13.33 | - | 3.37 | 3.61 | 6.26 | 5.93 | 30.0 | - | | | | | | |
| | Bd.ft.Gr.%: | 2.53 | 3.92 | 7.90 | 8.36 | 50.06 | 11.75 | 4.16 | 4.30 | 6.51 | 6.53 | 22.59 | 9.83 | | | | | | |
| La. 3 | Bd. ft. | 5,040 | 1,080 | 2,490 | 1,350 | 130 | 40 | 5,280 | 3,670 | 1,310 | 1,210 | 80 | - | 10,320 | 4,750 | 3,800 | 2,560 | 210 | 40 |
| | Cords | 11.1 | 2.9 | 8.8 | 5.2 | 1.2 | 0.2 | 15.4 | 11.6 | 6.2 | 6.4 | 1.8 | - | 26.5 | 14.5 | 15.0 | 11.6 | 3.0 | 0.2 |
| | Cds/MBM | 2.20 | 2.69 | 3.53 | 3.85 | 9.23 | 5.0 | 2.92 | 3.16 | 4.73 | 5.29 | 22.5 | - | | | | | | |
| | Bd.ft.Gr.%: | 1.11 | 3.24 | 8.16 | 8.73 | 40.31 | 8.50 | 2.84 | 3.62 | 5.68 | 5.62 | 23.13 | 3.64 | | | | | | |
| La. 5 | Bd. ft. | 2,290 | 1,720 | 3,170 | 1,710 | 130 | 40 | 4,690 | 3,200 | 1,200 | 1,050 | 90 | 20 | 6,980 | 4,920 | 4,370 | 2,760 | 220 | 60 |
| | Cords | 5.8 | 4.7 | 11.2 | 6.3 | 1.4 | 0.1 | 14.6 | 11.1 | 6.7 | 6.1 | 2.3 | 0.1 | 20.4 | 15.8 | 17.9 | 12.4 | 3.7 | 0.2 |
| | Cds/MBM | 2.53 | 2.73 | 3.53 | 3.68 | 10.77 | 2.5 | 3.11 | 3.47 | 5.58 | 5.81 | 25.6 | - | | | | | | |
| | Bd.ft.Gr.%: | 3.87 | 4.98 | 7.40 | 7.11 | 49.32 | 8.29 | 3.16 | 3.76 | 6.54 | 6.59 | 24.75 | 5.41 | | | | | | |
| Ark. 3 | Bd. ft. | 2,660 | 1,110 | 3,190 | 1,810 | 110 | 10 | 5,110 | 3,320 | 1,160 | 950 | 90 | 10 | 7,770 | 4,430 | 4,350 | 2,760 | 200 | 20 |
| | Cords | 6.6 | 3.2 | 11.5 | 6.8 | 1.6 | 0.1 | 15.9 | 12.6 | 7.1 | 6.5 | 2.7 | - | 22.5 | 15.8 | 18.6 | 13.3 | 4.3 | 0.1 |
| | Cds/MBM | 2.48 | 2.88 | 3.60 | 3.76 | 14.55 | 10.0 | 3.1 | 3.80 | 6.12 | 6.84 | - | - | | | | | | |
| | Bd.ft.Gr.%: | 3.07 | 5.80 | 5.54 | 5.47 | 17.57 | 9.64 | 3.14 | 4.00 | 5.49 | 5.33 | 9.72 | 7.52 | | | | | | |
| Ark. 4 | Bd. ft. | 4,240 | 1,660 | 2,730 | 1,650 | 160 | 40 | 640 | 1,100 | 340 | 420 | 120 | 40 | 4,880 | 2,760 | 3,070 | 2,070 | 280 | 80 |
| | Cords | 10.7 | 5.2 | 11.0 | 7.0 | 2.1 | 0.2 | 3.1 | 5.3 | 3.0 | 3.6 | 2.0 | 0.3 | 13.8 | 10.5 | 14.0 | 10.6 | 4.1 | 0.5 |
| | Cds/MBM | 2.52 | 3.13 | 4.03 | 4.24 | 13.1 | 5.0 | 4.84 | 4.82 | 8.82 | 8.57 | - | - | | | | | | |
| | Bd.ft.Gr.%: | 2.05 | 3.94 | 6.80 | 7.38 | 28.92 | 5.88 | 3.11 | 2.53 | 5.72 | 6.30 | 8.02 | 2.16 | | | | | | |
| Okla 1 | Bd. ft. | 3,370 | 1,170 | 1,540 | 920 | 100 | 50 | 940 | 1,280 | 530 | 520 | 80 | 10 | 4,310 | 2,450 | 2,070 | 1,440 | 180 | 60 |
| | Cords | 8.2 | 3.1 | 5.0 | 3.2 | 0.7 | 0.2 | 4.7 | 6.0 | 3.7 | 3.3 | 2.1 | 0.1 | 12.9 | 9.1 | 8.7 | 6.5 | 2.8 | 0.3 |
| | Cds/MBM | 2.43 | 2.65 | 3.25 | 3.48 | 7.0 | 4.0 | 5.00 | 4.69 | 6.98 | 6.35 | - | - | | | | | | |
| | Bd.ft.Gr.%: | 2.43 | 2.86 | 5.39 | 6.13 | 18.65 | 4.57 | 3.08 | 3.71 | 4.60 | 5.16 | 15.93 | 5.75 | | | | | | |

March 10, 1948

AVERAGE ACRE VOLUMES
and
BOARD FOOT GROWTH PERCENTS
Pine-Hardwood East

| State | Unit | Pine: Old growth: Uncut | Pine: Old growth: Partly cut | Pine: Second growth: Sawlog: Uncut | Pine: Second growth: Sawlog: Partly cut | Pine: Second growth: Under sawlog size | Pine: Repro. and clear cut | Hardwood: Old growth: Uncut | Hardwood: Old growth: Partly cut | Hardwood: Second growth: Sawlog: Uncut | Hardwood: Second growth: Sawlog: Partly cut | Hardwood: Second growth: Under sawlog size | Hardwood: Repro. and clear cut | Total: Old growth: Uncut | Total: Old growth: Partly cut | Total: Second growth: Sawlog: Uncut | Total: Second growth: Sawlog: Partly cut | Total: Second growth: Under sawlog size | Total: Repro. and clear cut |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ala. 2 | Bd. ft. | 6,246 | 1,529 | 3,262 | 1,867 | 220 | 66 | 4,752 | 3,126 | 1,079 | 877 | 163 | 9 | 10,998 | 4,655 | 4,341 | 2,744 | 383 | 75 |
| | Cords | 14.2 | 4.0 | 10.6 | 6.2 | 1.9 | 0.3 | 14.1 | 10.4 | 5.5 | 4.5 | 2.0 | 0.2 | 28.3 | 14.4 | 16.1 | 10.7 | 3.9 | 0.5 |
| | Cds/MBM | 2.27 | 2.62 | 3.25 | 3.32 | 8.64 | 4.55 | 2.97 | 3.33 | 5.10 | 5.13 | 12.27 | 22.22 | | | | | | |
| | Bd.ft.Gr.% | 1.89 | 3.55 | 6.85 | 6.67 | 31.76 | 7.73 | 2.16 | 3.43 | 6.43 | 5.83 | 12.83 | 23.54 | | | | | | |
| Ala. 3 | Bd. ft. | 3,803 | 1,762 | 2,728 | 1,658 | 186 | 54 | 4,172 | 2,827 | 1,111 | 1,005 | 86 | 22 | 7,975 | 4,589 | 3,839 | 2,663 | 272 | 76 |
| | Cords | 8.8 | 4.5 | 9.2 | 5.6 | 1.7 | 0.2 | 15.2 | 10.4 | 6.1 | 5.4 | 1.7 | 0.2 | 24.0 | 14.9 | 15.3 | 11.0 | 3.4 | 0.4 |
| | Cds/MBM | 2.31 | 2.55 | 3.37 | 3.38 | 9.14 | 3.70 | 3.64 | 3.68 | 5.49 | 5.37 | 19.77 | 9.09 | | | | | | |
| | Bd.ft.Gr.% | 2.38 | 3.33 | 6.75 | 6.32 | 35.20 | 7.56 | 3.52 | 3.66 | 6.90 | 6.65 | 25.60 | 3.56 | | | | | | |
| Ala. 4 | Bd. ft. | 4,212 | 1,063 | 2,405 | 1,308 | 175 | 35 | 3,048 | 2,643 | 952 | 804 | 127 | 21 | 7,260 | 3,706 | 3,357 | 2,112 | 302 | 56 |
| | Cords | 9.9 | 3.1 | 8.8 | 5.1 | 1.7 | 0.2 | 10.8 | 10.1 | 5.3 | 4.6 | 2.0 | 0.1 | 20.7 | 13.2 | 14.1 | 9.7 | 3.7 | 0.3 |
| | Cds/MBM | 2.35 | 2.92 | 3.66 | 3.90 | 9.71 | 5.71 | 3.54 | 3.82 | 5.57 | 5.72 | 15.75 | 4.76 | | | | | | |
| | Bd.ft.Gr.% | 2.57 | 3.49 | 7.02 | 7.85 | 31.35 | 12.46 | 3.35 | 3.23 | 6.48 | 6.41 | 13.76 | 3.68 | | | | | | |
| Ala. 5 | Bd. ft. | 4,338 | 2,324 | 3,039 | 1,875 | 197 | 42 | 1,514 | 1,163 | 534 | 477 | 82 | 6 | 5,852 | 3,487 | 3,573 | 2,352 | 279 | 48 |
| | Cords | 10.7 | 6.1 | 10.5 | 6.7 | 1.9 | 0.2 | 6.7 | 5.5 | 4.0 | 3.6 | 1.9 | 0.1 | 17.4 | 11.6 | 14.5 | 10.3 | 3.8 | 0.3 |
| | Cds/MBM | 2.47 | 2.62 | 3.46 | 3.57 | 9.64 | 4.76 | 4.43 | 4.73 | 7.49 | 7.55 | 23.17 | 16.67 | | | | | | |
| | Bd.ft.Gr.% | 1.95 | 3.18 | 5.85 | 5.61 | 27.41 | 6.73 | 2.87 | 2.96 | 6.04 | 6.30 | 14.62 | 16.49 | | | | | | |
| Ala. 6 | Bd. ft. | 715 | 563 | 1,957 | 850 | 103 | 41 | 2,995 | 2,620 | 1,007 | 757 | 127 | - | 3,710 | 3,183 | 2,964 | 1,607 | 230 | 41 |
| | Cords | 2.1 | 1.5 | 7.3 | 3.6 | 1.3 | 0.2 | 13.2 | 11.6 | 6.9 | 5.7 | 3.6 | negl. | 15.3 | 13.1 | 14.2 | 9.3 | 4.9 | 0.2 |
| | Cds/MBM | 2.94 | 2.66 | 3.73 | 4.24 | 12.62 | 4.88 | 4.41 | 4.43 | 6.85 | 7.53 | 28.35 | - | | | | | | |
| | Bd.ft.Gr.% | 2.74 | 3.39 | 6.70 | 6.36 | 34.28 | 5.94 | 2.85 | 4.11 | 5.41 | 5.54 | 21.75 | 21.75 | | | | | | |
| Miss. 2 | Bd. ft. | 430 | | 1,718 | 962 | 146 | 85 | 4,710 | | 2,066 | 1,495 | 294 | 74 | 5,140 | | 3,784 | 2,457 | 440 | 159 |
| | Cords | 1.2 | | 6.1 | 3.9 | 1.7 | 0.5 | 14.8 | | 9.8 | 7.4 | 4.3 | 0.5 | 16.0 | | 15.9 | 11.3 | 6.0 | 1.0 |
| | Cds/MBM | 2.79 | | 3.55 | 4.05 | 11.64 | 5.88 | 3.14 | | 4.74 | 4.95 | 14.63 | 6.76 | | | | | | |
| | Bd.ft.Gr.% | 3.02 | | 6.83 | 6.99 | 33.62 | 11.22 | 3.72 | 3.66 | 6.03 | 6.22 | 15.37 | 8.34 | | | | | | |
| Miss. 3 | Bd. ft. | 4,708 | 1,239 | 3,113 | 1,707 | 214 | 48 | 4,243 | 3,107 | 1,419 | 1,350 | 161 | 36 | 8,951 | 4,346 | 4,532 | 3,057 | 375 | 84 |
| | Cords | 10.6 | 3.2 | 10.0 | 5.7 | 1.7 | 0.2 | 13.4 | 10.4 | 6.8 | 6.5 | 2.4 | 0.4 | 24.0 | 13.6 | 16.8 | 12.2 | 4.1 | 0.6 |
| | Cds/MBM | 2.25 | 2.58 | 3.21 | 3.34 | 7.94 | 4.17 | 3.16 | 3.35 | 4.79 | 4.81 | 14.91 | 11.11 | | | | | | |
| | Bd.ft.Gr.% | 1.96 | 3.91 | 7.02 | 7.13 | 33.03 | 8.11 | 3.57 | 3.84 | 6.38 | 6.28 | 17.69 | 7.42 | | | | | | |

March 10, 1949

# AVERAGE ACRE VOLUMES
and
# BOARD FOOT GROWTH PERCENTS
Naval Stores

| State | Unit | Pine | | | | | | Hardwood (excluding cypress) | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Old growth | | Second growth | | | Repro- and clear-cut | Old growth | | Second growth | | | Repro. and clear cut | Old growth | | Second growth | | | Repro. and clear-cut |
| | | | | Sawlog | | Under sawlog size | | | | Sawlog | | Under sawlog size | | | | Sawlog | | Under sawlog size | |
| | | Uncut | Partly cut | Uncut | Partly cut | | | Uncut | Partly cut | Uncut | Partly cut | | | Uncut | Partly cut | Uncut | Partly cut | | |
| Ala. 1 | Bd. ft. | 3,878 | 2,503 | 2,292 | 2,431 | 190 | 81 | 3,048 | 912 | 283 | 398 | 56 | 5 | 6,926 | 3,415 | 2,575 | 2,829 | 246 | 86 |
| | Cords | 9.9 | 7.0 | 9.5 | 8.2 | 1.9 | 0.4 | 14.2 | 4.5 | 2.5 | 3.0 | 0.8 | 0.1 | 24.1 | 11.5 | 12.0 | 11.2 | 2.7 | 0.5 |
| | Cds/MBM | 2.55 | 2.80 | 4.14 | 3.37 | 10.00 | 4.94 | 4.66 | 4.93 | 8.83 | 7.54 | 14.29 | 20.00 | | | | | | |
| | Bd.ft.Gr.% | 2.87 | 4.46 | 9.03 | 6.43 | 30.15 | 8.07 | 3.40 | 5.21 | 9.80 | 8.36 | 14.35 | 5.54 | | | | | | |
| Miss. 4 | Bd. ft. | 1,805 | 1,626 | 2,322 | 1,921 | 197 | 56 | 4,749 | 1,821 | 978 | 713 | 70 | 5 | 6,554 | 3,447 | 3,300 | 2,634 | 267 | 61 |
| | Cords | 4.7 | 4.5 | 8.0 | 6.9 | 1.5 | 0.2 | 18.5 | 8.3 | 6.5 | 5.2 | 1.2 | 0.1 | 23.2 | 12.8 | 14.5 | 12.1 | 2.7 | 0.3 |
| | Cds/MBM | 2.60 | 2.77 | 3.45 | 3.59 | 7.61 | 3.57 | 3.90 | 4.56 | 6.65 | 7.29 | 17.14 | 20.00 | | | | | | |
| | Bd.ft.Gr.% | 3.67 | 4.64 | 9.55 | 8.52 | 29.12 | 12.44 | 3.27 | 4.90 | 7.02 | 6.55 | 12.36 | 5.85 | | | | | | |
| La. 4 | Bd. ft. | 6,558 | 1,427 | 3,315 | 2,582 | 148 | 32 | 5,409 | 2,696 | 552 | 751 | 159 | 8 | 11,967 | 4,123 | 3,867 | 3,333 | 307 | 40 |
| | Cords | 14.6 | 3.8 | 11.6 | 9.0 | 1.6 | 0.2 | 18.6 | 10.9 | 3.8 | 4.5 | 1.9 | negl. | 33.2 | 14.7 | 15.4 | 13.5 | 3.5 | 0.2 |
| | Cds/MBM | 2.23 | 2.66 | 3.50 | 3.49 | 10.81 | 6.25 | 3.44 | 4.04 | 6.88 | 5.99 | 11.95 | - | | | | | | |
| | Bd.ft.Gr.% | 1.85 | 4.60 | 10.12 | 8.47 | 43.91 | 12.31 | 2.84 | 4.65 | 7.25 | 5.95 | 10.48 | 3.93 | | | | | | |

NOTE: Bd. ft. -- Board foot volumes, Int. 1/4" rule; Pine (and cypress in pine-hardwood units) 9.0" d.b.h. and larger; Hardwoods (and cypress in Delta units) 13.0" d.b.h. and larger.

Cords -- Standard, rough cords (outside bark); Pine 5.0" d.b.h. and larger (including pulpwood tops of sawlog-size trees); Hardwoods (and cypress in pine-hardwood and Delta units) 5.0" d.b.h. and larger (excluding tops of sawlog-size trees).

Cds/MBM -- Ratio of total cords per 1,000 board feet.

Bd.ft.Gr.% -- Gross annual compound rate of board foot growth (Int. 1/4" rule) in percent of sawlog volume, including ingrowth, computed from 10 year periodic growth estimate.

## AVERAGE ACRE VOLUME
Mississippi River Delta

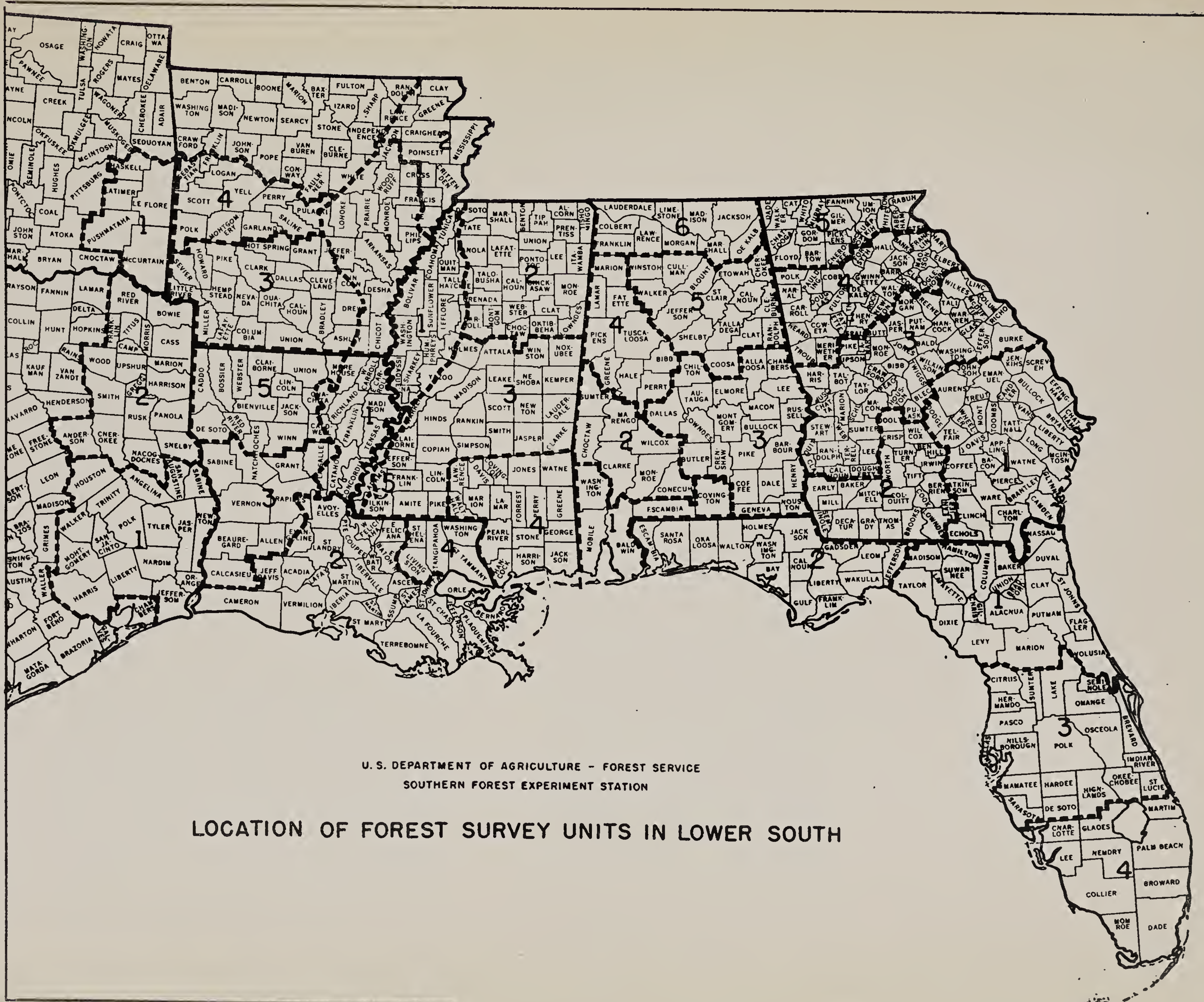
| State | Unit | Hardwood (including cypress and pine) — Old Growth — Uncut | Old Growth — Partly cut | Second Growth — Sawlog — Uncut | Second Growth — Sawlog — Partly cut | Second Growth — Under sawlog size | Repro. and Clear-cut | Cords per M sawlog size trees |
|---|---|---|---|---|---|---|---|---|
| Miss. 1 | Bd. ft. | 8,893 | 4,334 | 3,615 | 2,585 | 228 | 79 | 2.47 |
| | Cords | 24.8 | 12.9 | 13.3 | 9.9 | 3.6 | .3 | |
| | Cds/MBM | 2.79 | 2.98 | 3.68 | 3.83 | 15.79 | 3.80 | |
| | Bd.ft.Gr.%: | 1.83 | 3.00 | 6.56 | 6.58 | 28.24 | - | |
| La. 1 | Bd. ft. | 6,368 | 3,385 | 3,973 | 2,865 | 792 | 131 | 2.47 |
| | Cords | 18.6 | 11.3 | 15.2 | 11.4 | 6.0 | 0.7 | |
| | Cds/MBM | 2.92 | 3.34 | 3.83 | 3.98 | 7.58 | 5.34 | |
| | Bd.ft.Gr.%: | 2.01 | 3.20 | 5.70 | 5.50 | 12.25 | 9.15 | |
| La. 2 | Bd. ft. | 4,980 | 4,293 | 2,520 | 2,006 | 181 | 45 | 2.55 |
| | Cords | 14.8 | 14.9 | 12.3 | 8.7 | 4.8 | 0.3 | |
| | Cds/MBM | 2.97 | 3.47 | 4.88 | 4.34 | 26.52 | 6.67 | |
| | Bd.ft.Gr.%: | 2.59 | 2.93 | 6.88 | 6.02 | 29.77 | 8.59 | |
| Ark. 1 | Bd.ft. | 7,336 | 3,575 | 2,830 | 1,926 | 270 | 71 | 2.53 |
| | Cords | 24.5 | 12.7 | 13.0 | 8.2 | 5.0 | 0.4 | |
| | Cds/MBM | 3.34 | 3.55 | 4.59 | 4.26 | 18.52 | 5.63 | |
| | Bd.ft.Gr.%: | 3.02 | 2.82 | 7.00 | 7.33 | 20.86 | 4.64 | |
| Ark. 2 | Bd. ft. | 10,570 | 3,664 | 2,660 | 1,754 | 195 | 42 | 2.54 |
| | Cords | 29.5 | 12.5 | 11.9 | 8.7 | 4.2 | 0.3 | |
| | Cds/MBM | 2.79 | 3.41 | 4.47 | 4.96 | 21.54 | 7.14 | |
| | Bd.ft.Gr.%: | 1.87 | 3.51 | 7.59 | 7.76 | 30.92 | 8.89 | |

MORTALITY PERCENTS

Board feet (International 1/4 inch rule)

Average Annual Loss

| State Unit | Pine | | | | | | Hardwood (including cypress) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Old growth | | Second growth | | | Repro. and clear-cut | Old growth | | Second growth | | | Repro- and clear-cut |
| | | | Sawlog | | Under-sawlog size | | | | Sawlog | | Under-sawlog size | |
| | Uncut | Partly cut | Uncut | Partly cut | | | Uncut | Partly cut | Uncut | Partly cut | | |
| Pine-Hardwood: West | | | | | | | | | | | | |
| Texas 1 | 0.96 | 1.01 | 0.33 | 0.60 | 1.13 | 1.80 | 0.72 | 0.80 | 1.06 | 0.79 | 1.30 | 1.29 |
| Texas 2 | 0.21 | 1.17 | 0.54 | 0.96 | 2.52 | 7.26 | 0.73 | 0.73 | 1.56 | 1.17 | 2.36 | 6.75 |
| La. 3 | 2.13 | 0.31 | 0.37 | 1.01 | 2.26 | 1.72 | 0.44 | 0.67 | 0.85 | 1.18 | 1.50 | 7.34 |
| La. 5 | 1.39 | 0.88 | 0.56 | 0.95 | 2.73 | 10.80 | 0.82 | 0.90 | 1.19 | 1.20 | 2.92 | 9.09 |
| Ark. 3 | 0.20 | 0.32 | 0.33 | 0.76 | 2.60 | 73.97 | 0.99 | 0.69 | 1.05 | 1.14 | 2.66 | 8.47 |
| Ark. 4 | 0.43 | 0.18 | 0.27 | 0.49 | 2.86 | 4.30 | 3.19 | 1.92 | 2.86 | 2.44 | 4.67 | 2.05 |
| Okla. 1 | 0.97 | 0.71 | 0.78 | 0.85 | 1.93 | 3.31 | 4.70 | 3.30 | 4.39 | 3.69 | 4.36 | 17.78 |
| Pine-Hardwood: East | | | | | | | | | | | | |
| Ala. 2 | 0.23 | 0.72 | 0.46 | 0.89 | 0.83 | 0.72 | 0.68 | 0.57 | 0.66 | 0.63 | 0.69 | 0.57 |
| 3 | 0.83 | 1.16 | 0.66 | 1.12 | 3.07 | 7.51 | 1.05 | 0.95 | 0.70 | 0.72 | 1.90 | 4.62 |
| 4 | 0.68 | 1.76 | 0.77 | 0.85 | 1.53 | 0.27 | 0.77 | 0.43 | 0.76 | 0.76 | 1.28 | 0.43 |
| 5 | 1.87 | 1.46 | 1.10 | 1.30 | 3.48 | 9.91 | 0.46 | 1.14 | 0.92 | 1.21 | 2.02 | 4.88 |
| 6 | 1.11 | 0.45 | 1.20 | 1.27 | 3.16 | 3.90 | 1.35 | 0.78 | 2.00 | 1.55 | 4.06 | - |
| Miss. 2 | 0.84 | 0.84 | 0.36 | 0.84 | 0.97 | 3.32 | 0.79 | 1.35 | 0.52 | 0.45 | 1.72 | 12.40 |
| 3 | 0.98 | 1.08 | 0.67 | 1.10 | 1.76 | 3.63 | 0.80 | 0.77 | 0.82 | 0.83 | 1.92 | 1.09 |
| Naval Stores | | | | | | | | | | | | |
| Ala. 1 | 1.09 | 1.34 | 1.42 | 1.33 | 2.56 | - | 0.66 | 1.27 | 1.59 | 1.08 | 1.10 | - |
| Miss. 4 | 1.20 | 1.78 | 1.02 | 0.68 | 1.78 | - | 0.31 | 0.41 | 0.66 | 0.50 | 0.53 | 0.41 |
| La. 4 | 1.60 | 1.39 | 1.06 | 1.66 | 4.13 | - | 0.75 | 0.83 | 1.21 | 1.20 | 1.13 | 0.83 |



U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE
SOUTHERN FOREST EXPERIMENT STATION

LOCATION OF FOREST SURVEY UNITS IN LOWER SOUTH

S
SUPERVISION
Meetings
Management Plan Conference

March 25, 1949

# A CONTINUOUS INVENTORY BASIS FOR DETERMINING GROWTH, MORTALITY AND YIELD*

by
James G. Osborne
In Charge, Biometrics
Division of Forest Economics

## Definition

The term "continuous inventory" as used in this paper is applied generally to the methods of growth prediction which depend upon remeasurement of permanent sample plots. It is not to be confused with the term as used historically by Kirkland in describing Biolley's "Methode du Controle." The term is used here to provide a contrast with methods of growth estimation and prediction that are based on a single measurement as is the case with yield table and stand table projection methods. Also, it is in contrast with estimates based on independent periodic surveys in which new sample plots are measured at each resurvey. The term is selected because at least in certain variations of the method it may be used to estimate the inventory at any time period. The continuous inventory system is subject to a wide variation in methodology and hence should not be considered as a specific system, but rather a concept.

## Advantages and Disadvantages

Since the method is based upon the remeasurement of permanent sample plots it has certain advantages not available to the yield table method or the stand table projection method. First, it enables the direct measurement of both gross growth and mortality as well as cutting, and second, it does not rely upon assumptions as to the continuation of established growth rates of individual trees, assumptions as to bark growth, or on estimates of the period of time since the death of an individual tree. It also does not necessarily make references to stand normality or approaches of over-stocked or under-stocked stands to normality as does the normal yield table method. The papers on these two methods will doubtless elaborate on the risks, strength, and weaknesses of those methods and for that reason they will not be discussed further in this paper. The principle disadvantage of the continuous inventory method is that for direct application it is necessary that a growth period elapse before growth can be estimated. Forecasts of future growth involve an assumption: that in any future period a stand

---

* To be presented at the Management Plan Conference, Hot Springs, Arkansas, March 28 - April 8, 1949.

of specific character will grow in the same way as a stand of the same character at the beginning of the growth period grew in the period studied. The consequences of this assumption which specifies that climatic and soil fertility conditions remain constant do not seem serious and this assumption is unavoidable in any growth prediction method.

It should be pointed out that for best use of this method, the growth period should be long enough that growth measurement errors are relatively small in comparison with total growth. In this regard, it would seem that short growth periods which result in greater accuracy by yield-table and stand-table-projection methods result in less accuracy by the continuous inventory methods; longer growth periods reverse this relationship.

Field Difficulties

Difficulties in the application of the continuous inventory or permanent sample plot method arise from two sources: (1) difficulty of exact relocation of the plot, and (2) bias due to a plot's being treated differently than the remainder of the stand of which it is a sample. Unfortunately, some methods of eliminating the first of these difficulties accentuate the second.

Opponents of the permanent sample plot method point to the possibility that even a small change in the plot boundary at time of remeasurement may result in the inclusion of one or two large trees not included when the plot was established, and hence the addition of the entire end-period volume of these trees to the growth of the plot trees resulting in a large over measurement. The reverse is equally likely, of course, resulting in a serious under measurement. Even recognizing that such errors do not necessarily bias the results, they would play havoc with any correlations and greatly increase the error of the growth estimate.

This error can be greatly reduced, if not eliminated entirely, by precise surveying and complete reference notes, or by marking plot centers or corners conspicuously and indestructably. Both of these expedients are costly and the latter increases the likelihood of the plot's being handled unrepresentatively, whether wilfully or unconsciously. Apparently the experience of foresters differs greatly as to the seriousness of this difficulty.

If the plots are not too large, and if a stand tally by species and diameters is taken into the field at the time of remeasurement, it should be possible to eliminate the error of including outside-boundary, or excluding inside-boundary trees. If the technique of stem map is used, the dangers of this error seem inconsequential.

Since the plots in which the group here would be interested would all be located on national forest land, it should be possible to eliminate the possibility of the sample plot being treated in an unrepresentative fashion

through education of forest personnel as to the purpose of the growth plots. If not, the plots should be located and mapped carefully and marked as inconspicuously as possible. Spotting of plots on aerial photographs should aid in this.

As a final comment, it would seem to me that if it is important to actually measure gross growth and mortality which, at the present time seems possible only by permanent sample plots, ingenuity of Forest Service personnel should be equal to the task of eliminating these two difficulties in a practicable manner.

As was indicated, the method may be applied in a wide variety of ways. These depend upon the amount of detail needed and upon the additional information which it is hoped to obtain as well as upon the estimate of the degree of certain correlations involved. For comparison the methods will be elaborated upon in what follows. The presentation of the methods will be in order of the extent to which additional variables enter the picture.

Direct Sampling of Growth

The simplest method of growth estimation is that of direct sampling of measured growth and mortality. By this method the number of sample plots calculated to be required to obtain the specified accuracy is established and measured, then all plots are remeasured at the end of the growth period. This method treats growth in exactly the same manner as volume in a sample cruise in that it is measured directly on a sample basis and expanded to the entire area on a direct sampling rate basis. Just as in volume sampling, it should be generally possible to improve the estimate by stratified sampling in which the area in each stratum is determined from aerial photograph examinations or from type and condition maps. If growth is to be estimated by this method then the predicted growth would be simply the measured growth for the past period for each stratum expanded by the new area in each stratum.

Double Sampling with Regression based on Volume Alone

The second simplest method of sampling for growth involves what is known as double sampling. By this method the procedure is as follows: Again with the area subdivided into strata of types and age or stand-size classes, a relatively large number of plots is established and the volume of each of these plots is measured. At the end of the growth period a sample of the plots in each of the strata is remeasured to determine the growth and mortality that has taken place. Separately the growth and mortality of the plots in the subsample of each stratum are correlated by standard least-squares regression method, with the initial volumes to obtain an estimating equation. If the equation is linear the average initial volume of the original large sample is used in this regression equation to provide a better estimate than is available from the subsample of plots alone of the average

growth per plot for each stratum. These average values are expanded by the stratum areas to obtain estimates of the growth and mortality for the entire unit. If the regression is curved, volumes plot by plot would be used in the regression to estimate average growth. This method provides in the process somewhat more information than the first method in that the regression equation relating volume growth to volume at the beginning of the period gives a measurement of the effect of the variation in the original stand volume on growth and hence provides a rough guide as to the desirable reserve volume in each type and stand size class. This information also is available if the direct sampling method is used but requires additional analysis.

An advantage of this and other regression methods used with double sampling is that predictions or estimates can be made for small areas with greater confidence. The regression equation being based on all remeasured plots in the stratum is evaluated better than if based on the small area alone and hence brings data from the entire study to bear on the small area estimate.

By both the first and the second method the initial sample should be designed according to the statistical theory of optimum allocation. By this theory the number of plots to be measured in each type and stand-size class should in this case be proportional to the product of the standard deviation of volume within the stand-size class and the area in the stand-size class. In the second method the number of plots to be remeasured for growth in each size class depends directly upon the extent of the correlation to be expected in the regression of volume growth on volume. Further the plots to be remeasured should represent, as far as possible, the range of initial volumes and should be distributed throughout the range in a reasonably uniform pattern.

This method may be modified profitably by including certain additional measurements which are designed to increase the accuracy of the prediction or the extent of the correlation. For example, it may be profitable to include in the growth equation the percentage of the total volume in selected species or groups of species and the percentage in selected tree or crown-canopy classes. Inclusion of the later variables should not only improve the estimate, but also should give additional information as a partial guide to the more desirable types of residual trees as well as the most desirable residual volume for each type and stand-size class. This modification requires the fitting of multiple regression equations in contrast with the single variable equation when these variables are not included. Beyond the additional work it is felt that little can be lost since if any of the variables prove to be non-significant, it can be omitted and the analysis based on volume alone, and there is likelihood of substantial gain in accuracy. This form of growth prediction equation has been used by Dunning and Clements of the California Forest Experiment Station in predictions of growth in the mixed conifer stands in the Sierras. (I do not believe that their results have been published but should be available at the Station. Perhaps Hasel will comment on this and on the merits of the method.)

Double Sampling Regression on Total Stand Measurement Components

The next modification is somewhat more complex in that it uses the characteristics of stand structure and its composition in terms of species and tree class. As with the previous methods the first step would be that of a sample of each type and stand-size class to obtain a relatively precise estimate of the stand characteristics of number of trees, and diameters by species. By this method the techniques followed by Buell in his study of growth of Southern Appalachian Hardwood Stands or some modification of them would be used to calculate the growth prediction equation. (Duke University School of Forestry, Bulletin 11) Buell used as his variables (1) the number of trees per unit of area, (2) the sum of the diameters measured at breast height, and (3) the sum of the squares of these diameters. Buell found that when the number of plots available for growth estimates was substantial, the errors of growth estimates were quite acceptable, being in most cases from ~~4~~ 10 to 12 percent. He found that the addition of a fourth variable, density, was of value in very few instances and generally recommended limiting the variables used to those mentioned. Because of the form of his growth equation, he was also able to estimate the effect of individual tree size on all growth variables (i.e. ~~gross~~ SURVIVOR growth, net growth, ~~and~~ mortality, AND in growth) and consequently to provide a guide to the method of cutting.

With these data, Buell found that separate growth equations were needed for each of his second-growth types but that a single equation was adequate for all old-growth types.

This method would be used in a manner similar to those already described in that the number of plots remeasured as a basis for calculating the growth equation would be substantially less than the number originally established both for inventory purposes and to provide an adequate sample of the average for each of the stand characteristics used in the growth equation. Again the same statistical principles should be followed in the selection both of the number of plots in the initial sample of the stand size classes and in the selection of the plots to be remeasured to cover the range of each of the regression variables in a rather uniform manner.

Double Sampling with Regression on Single Tree Measurements

The last and most complex variation of this method is that of basing growth on the relationship of the growth of an individual tree to its position in the stand and on the characteristics of the stand. As in the preceding cases the initial step is a relatively large sample in each of the type and stand-size classes to provide a good estimate of the typical plot in each of these classes. For the plots which are to be used to prepare the growth equation by this method, it is necessary to make provision for individual tree reidentification. This can be done either by tagging the trees or preferably by spotting the trees on a plot map. A procedure for making plot maps is described in a paper by Stott and Regan, Journal of Forestry,

April 1939, "Permanent Sample Plot Technique Adapted to Commercial Timber Stands," which has been used extensively and successfully both by Regions 9 and by the Lake States Forest Experiment Station.

By this method the growth of each tree would be measured and recorded. An equation would then be prepared in which the dependent variable would be growth and the independent variables as a minimum would be the size of the tree on which the growth is measured relative to the size of the average tree on the plot, the site, and a measure of stand density. Experience is not available as to the best form of this equation nor as to which additional variables are likely to be found useful in a specific situation. In all probability separate equations would need to be prepared for each stand-size class and probably for each tree class. It is questionable whether species would differ markedly enough in their growth habits under conditions controlled to this extent to warrant the preparation of separate equations or adjustments for each species. Possibly it would be necessary to prepare equations for groups of species, but this, as is true of the other variables mentioned, is subject to test by a statistical evaluation of the significance of the regression coefficients.

By this system mortality volume by tree class, species, and diameter may be so weakly determined that average values should be used. Probably it would be desirable to relate mortality to total volume, basal area, or some other total plot characteristic.

Growth equations calculated in this method would then be applied to the specific tree records plot by plot for all plots in the large sample. The average growth so obtained would then be expanded to the area in each type and stand-size class to obtain the estimate of growth for the entire stand.

The prediction of future growth by both of the last two methods would result from the application of the growth equations found to stands as estimated following the first remeasurement period. In both cases it is necessary to estimate not only the past growth but also the stand composition of the plots which were measured in the initial large sample but which were not remeasured for growth determination.

Briegleb's Study

An outstanding example of the use of individual tree characteristics is Briegleb's method as described in his paper "Calculating the Growth of Ponderosa Pine Forests" published by the Pacific Northwest Station, December 28, 1945. The variables used by Briegleb were Keen tree class and diameter with adjustments for stand volume, reserve volume following cutting, and site. By his method Briegleb estimates gross growth of saw-timber size trees, ingrowth from pole-size trees, and mortality, separately. Net growth is obtained by adding and subtracting the components.

For application of this method using the tables and alinement charts provided in the study, the following statistics are needed:

1. Area

2. Stock table, showing average saw-timber volume per acre in trees 11.1 inches in d.b.h. and larger, by species, diameter class, and for the ponderosa pine, by Keen tree class.

3. Average number of poles per acre, i.e., trees 3.0 to 11.0 inches in d.b.h., by species, diameter class, and for ponderosa pine, by Keen tree class.

4. Site quality class or site index.

As a measure of competition, and its effect on growth Briegleb used initial volume and the percent reserved for his variables.

Technical Advantages of Individual Tree Systems

The method of growth estimation based on the growth equation of individual trees according to their description and the stand in which they grow seems to have a technical advantage over methods based on stand totals. Unlike methods based on stand totals, this method is flexible and enables including changes in the shape of the growth curves as these might be brought about by changes in stand density and average-tree size.

Changes brought about by partial cutting can be evaluated since not only is the volume removed known but also the species, size, and tree-class of the individual trees removed can be determined on a sampling basis.

A third advantage is that specific description is known also of the trees that die during the remeasurement cycle.

Error Equations by the Various Modifications

Some indication of the relative desirability of each of the methods of applying the continuous inventory--or permanent sample plot--technique is available from examination of the estimating and error equations. It is assumed that in all cases, the working circle is subdivided into mapped type and stand-size-class strata.

1. Simple stratified growth sampling:

$$T = A_1\bar{g}_1 + A_2\bar{g}_2 + - + A_kT_k$$

where $T$ = total growth

$A_i$ = area in stratum $i$ in plots; $i = 1, 2, \ldots k$

$\bar{g}_i$ = average growth per plot in stratum $i$.

The sampling variance of $T$ is:

$$\sigma_T^2 = A_1^2 \sigma\bar{g}_1^2 + A_2^2 \sigma\bar{g}_2^2 + \quad + A_K^2 \sigma\bar{g}_K^2$$

(In this and the formulae that follow it is assumed that no error is made in determining the area in each stratum. Actually this will sensibly be true if sample plots are classified according to the mapped type and stand size class and not adjusted according to the plot composition.)

According to this formula, the error of the total depends upon the number of plots in each stratum. This error is minimized by making the number of plots in a stratum proportional to the product of the area by the standard deviation within the stratum.

2. Double sampling with reserve volume as a measure variable. In this case, an equation relating growth to volume is prepared for each type, site, and possibly stand-size class.

$$G = \bar{G} + b_{GV}(V - \bar{V})$$

where G = plot growth

$\bar{G}$ = average growth of plots on which growth is measured

V = initial plot volume

$\bar{V}$ = average initial volume of plots measured for growth

The growth estimate for the entire working circle would be:

$$T = A_1\left\{\bar{G}_1 + b_{GV_1}(\bar{V}_1' - \bar{V}_1)\right\} + A_2\left\{\bar{G}_2 + b_{GV_2}(\bar{V}_2' - \bar{V}_2)\right\}$$
$$+ - - - + A_K\left\{\bar{G}_K + b_{GV_K}(\bar{V}_K' - \bar{V}_K)\right\}$$

where T = total growth

$\bar{G}_i$ = average growth of the plots in the $_i$th stratum on which growth was measured

$\bar{V}_i$ = average initial volume of the plots in the $_i$th stratum on which growth was measured

$\bar{V}_i'$ = average initial volume of all plots in the $_i$th stratum (i.e. including those not remeasured for growth).

The sampling variance of growth of the entire working circle would be:

$$\sigma_T^2 = A_1^2 \left\{ \frac{\sigma^2_{G.V_1}}{n_1} + (\bar{V}_1' - \bar{V}_1)^2 \frac{\sigma^2_{G.V_1}}{\sum_{j=1}^{n_1} (V_{1j} - \bar{V}_1)^2} + b^2_{GV_1} \; \sigma^2 (\bar{V}_1') \right\}$$

$$+ - - - + \text{for "}k\text{" similar terms,}$$

where $n_1$ = number of plots remeasures for growth in stratum 1, etc.

and $\sigma^2_{\bar{V}_1'} = \dfrac{\sigma^2_{V_1}}{n_1'}$ where $n_1'$ is the total number of volume plots in stratum 1.

From the form of this equation it is evident that the error is reduced by increasing the spread of volumes of the plots on which growth is measured, as well as by increasing the number of observations on which both the regression equation average and the general sample plot volume average are based.

Estimating and error equations are not included here for the more complex methods since they become unwieldly but the same principles are involved. These are the sampling errors of the regression equations relating growth to tree, stand, and site characteristics, and the sampling errors of determining average values for these variables from which growth is estimated.

In general it should be found that the more variables used in the growth equations and the higher the correlation, the smaller would be the number of field plots required to be remeasured for growth.

## Continuity of the System and Forecasting

In the interests of brevity, much of what has been covered has related to the estimation of past growth and to prediction for a single period. To cover modifications in application for the extensive future, and general forecasting, in full, would require considerable duplication. Perhaps it will suffice to indicate a little more fully my thoughts on continuous application without spelling out specific procedures in detail.

First, subsequent remeasurement of the growth-plot sample will provide direct samples, for each stratum, of the inventory on the stratum as a whole. The accuracy of this estimate can be improved by adjusting to the original large-sample base. A comparison, and regression for estimating purposes, of the growth actually measured at the end of the second and subsequent growth periods with that predicted will enable adjusting the original equation for biases arising from the response of reserve trees

to release following cutting. Thus, through a series of remeasurements not only is a sample of the inventory maintained both as to total volume and its components, but also the growth prediction equation becomes more and more sensitive and is adjusted to changes in growth rates due to improvement or change in the description of the average tree.

With continuing purification of the mapped types, sites, and stand-size classes, the ultimate answer to be sought is a dependable table of average composition and growth rates for each stratum that can be delineated. Armed with such tools growth might be estimated in exactly the same way, and with the same relative precision as we now hope to estimate total gross volume from photographic type and stand-size-class stratification in inventory surveys. All that would be required is keeping continuously up-to-date an accurate delineation of these strata.

## Modification for Immediate Growth Prediction

If it is required to make a growth prediction at the time of the initial sampling the general methodology described in the last two sections can be employed by taking increment core measurements. This procedure is not recommended since it is subject to all of the weaknesses inherent in single measurement methods which require the estimation of the stand at the beginning of the past growth period. By this modification one would estimate the growth on each plot by subtracting growth as measured by increment cores of the living trees and by estimating the size of the trees now dead which were presumed to be living at the beginning of the period. With these modifications, growth estimating equations would be calculated by exactly the same procedures as those described in the last two sections. Growth during the future period would be predicted by applying the growth equation so calculated to the stand as measured at the time of the initial inventory.

## Summary

In this paper has been described a concept which has several variations in method of implementation to estimate growth by means of permanent sample plots. The method has the advantage over single measurement temporary plot methods in that it does not require assumptions in the estimates of mortality and it provides a direct measurement of both net and gross growth. It also involves no assumptions as to the relationship of past growth of individual trees to their future growth. It includes also the bark growth. Since this method is based on actual growth measurement its errors are confined to sampling errors and the statistical errors in regression equations.

The methods described proceed from the simplest which is a direct stratified sampling of growth through the use of double sampling to the inclusion of progressively more variables in the growth estimation equation. It contrasts methods which are based upon total stand measurements and individual tree measurements.

The method has the weakness that a growth period must expire before the complete benefits of the method can be realized and requires overcoming several practical field measurement problems.

Quotations

In concluding, I should like to read two quotations bearing on this subject. The first is a memorandum for the record by R. D. Garver, Director, Forest Survey, dated March 17, 1949.

"Discussion with Mr. Barrett regarding the problems inherent in remeasurement of sample plots.

"If the Survey in its maintenance work expects to remeasure plots under some form of continuous inventory system, then the following points, in Barrett's opinion should be given special attention:

"1. When the plots are initially established, mark the center with a stake which can be expected to last throughout the 10-year period. Bearing trees are desirable but need not be marked if they are carefully referenced by bearing distance from the center stake.

"2. Special effort should be made to be sure every tree is measured and recorded. This is especially necessary where trees occur on the perimeter of the sample plot circle. For growth plots, it is especially necessary that great care be exercised by the men measuring the trees so as not to unduly damage the bark flakes on the trees. The point at which d.b.h. is measured can be determined satisfactorily by measurement from the ground. Location of this point by paint or other material is not considered necessary. It is imperative that trees dead at establishment of the plot be blazed to sound wood or otherwise marked unmistakably to enable accurate measurement of the mortality occurring between measurements.

"3. If plots are to be used for determining growth, through remeasurement at intervals, then it is absolutely essential to locate the plots on the remeasurements with precision. To locate a plot approximately--say within two chains--and then remeasure the trees, and attempt to correlate them with the initial plot is not considered feasible.

"4. At certain stages in the life of shortleaf pine, for example according to Barrett, the bark seems to slough off naturally as the tree gets older. This is apparently something like the change in western yellow pine from the bullpine to the yellow pine stage. Barrett recalled cases where the natural

sloughing of the bark was sufficiently great to reduce the d.b.h. remeasurements so that no growth was indicated.

"5. In spite of the difficulties of remeasuring plots, Barrett is of the opinion that this is the best way to obtain information on growth for growth-prediction purposes or for determining periodic increment.

"These points are noted because of their bearing on the technique which the Survey expects to adopt in carrying out some form of continuous inventory system."

The second is from U.S.D.A. Technical Bulletin No. 796, "Methods of Forecasting Timber Growth in Irregular Stands," by W. G. Wahlenberg.

"On the other hand, the recurring-inventory system provides a means of determining current increment in volume, basal area, or diameter by diameter classes, and can be applied by sample plots, strips, whole stands, or forests. Because of its speed and relative cheapness, it appears best suited to large areas. Recurring inventories of timber on each working circle would place the regulation of American forests on a firmer basis."

S
SUPERVISION
Meetings
(Management Plan Conference)

Portland, Oregon

March 21, 1949

## TOPIC 18 - MANAGEMENT PLAN CONFERENCE

## METHODS NOW USED IN CALCULATING GROWTH, MORTALITY, AND YIELD

Dahl J. Kirkpatrick

My part of this assignment is to review for you the methods (not the technology) being employed in Regions 1, 2, 3, 4, 5, 6 and 9 for the calculation of growth, mortality, and yield. Mr. Streinz has kindly consented to present comparable data for Regions 7 and 8. Except for Region 6 the information which follows is digested from replies to my request to the several regions, and if I have misinterpreted their statements, I trust that the regional representatives will feel free to say so in order that the record will be straight. There are a few generalizations that may be drawn from the information which was supplied in response to my inquiry, but these can better be stated after I have briefly described the programs being followed.

Region 1. Region 1 generally is faced with the problem of developing plans of management for forests which contain surplus acreages of old, overmature timber, and young growth which has come in following the 1910 fires. There is a shortage of age classes in between and the chief concern is to so regulate the cutting of the old stands that they will bridge the gap. Methods of cutting vary with forest types. Some types of stand are clear cut; others, selectively cut. For this reason it is Region 1 practice to analyze each type within a working circle separately. This Region employs normal yield tables, adjusted for stocking, in forecasting growth in their management planning work. Adequate yield tables are not available for all of their forest types, and they plan to make up the deficiency by establishing permanent sample plots. Growth information from permanent study plots is particularly needed, the Region feels, for use in their selectively-cut ponderosa pine and larch-Douglas-fir types. Fairly reliable information is available for uncut stands of these types, but the impression I gained from their statement on the subject was that they believe that in the future, reliance should be put upon the permanent plot system of determining growth and mortality for the calculation of permissible allowable annual cut.

Region 2. Region 2, with the exception of the Black Hills area, has in common with other western regions the problem of converting virgin stands of overmature decadent timber to managed stands. Their policy as to how this shall be done is not fully settled. They seem to feel that in many of their management units ingrowth and the growth in younger stands is completely offset by losses in the overmature stand elements. If it is determined that sustained yield is to be practiced in these working circles, considerations of growth and yield are not too pertinent at the present time. The problem is strictly one of salvaging surpluses of overmature and decadent timber during the first cutting cycle. In managed stands where cutting has taken place, growth and mortality are measured by use of alignment charts which in turn are based upon permanent sample plot information.

Region 3. In Region 3 it is estimated that 60% of the original virgin areas has still to be cut over in order to bring the stands into growing condition. It is the desire of the Region to do this as rapidly as possible and their management is aimed at this objective without too much preoccupation with problems of growth and yield. Virgin stands are not considered to have net increment. For predicting growth in stands which have been put into productive condition through cutting, the Region uses the results of growth studies conducted on the large management plots at the Fort Valley Experiment Station. These are not applicable on a Region-wide basis, but from them stem a large part of the Region's available growth and yield information. In some instances empirical growth tables are used based upon temporary sample plot information.

Region 4. Region 4 for purposes of predicting growth, yield, and mortality relies almost entirely upon the use of stand projection determinations. Their data is based upon stand projection measurements in both virgin and cutover stands. It is the Region's feeling now that the former are of questionable value and that more studies in cutover areas are needed. In but one section of the Region has growth and yield data from sample plots been employed. Mortality information is based upon permanent sample plot findings insofar as possible, and plans to extend the use of sample plots for mortality determinations are being developed.

Region 5. Region 5 has over most of its area a surplus of growing stock in mature and decadent timber. Their management is aimed at reducing these surpluses and placing their stands in condition for growth. For purposes of forecasting yield, Region 5 employs a set of alignment charts which have been developed from permanent sample plot studies. These are adjusted to adopt them to stands of varying species composition, tree size, and site.

Region 6. In Region 6 two general forest conditions and methods of management prevail. The west side types are generally subjected to even-aged management while the ponderosa pine forests on the east side are managed on an uneven-aged basis. In the former case the predominant problem is to prorate the cutting of mature and overmature stands in such a way that sufficient quantities of young timber will come of age, by the time the old growth is gone, to permit a relatively even rate of production. For this, normal yield tables adjusted for site and stocking are universally applied in the calculation of growth, yield, and mortality. In the east side types where partial cutting is the rule, growth, mortality, and yield forecasts are based upon the results of temporary and permanent sample plot studies in both cutover stands and uncut forests. These data are now in the process of being checked and refined, using actual growth and mortality experience.

Region 9. In Region 9 the immediate management problem is generally one of building up a depleted growing stock--not in placing mature and decadent stands in a condition of growth. In that respect their job is different from that which prevails in the western regions. Their method of calculating growth, mortality, and yield is based in large measure upon the use of the principle of stand projection.

From the replies and the discussions provided by the several Regions on the general problem of applying growth, mortality, and yield considerations to management planning, a few generalities may be drawn.

1. No one appears to feel fully satisfied that growth, yield, and mortality data available to them are entirely satisfactory. This is particularly true for working circles having extensive acreages of cutover stands.

2. In the western regions where many working circles are predominantly in virgin timber, management planners appear to feel no immediate concern for extremely precise growth, yield, and mortality data.

3. Almost without exception there was expression favoring the establishment of permanent sample plots in areas cut over for the purpose of providing a more adequate basis for sustained yield calculations during second and subsequent cutting cycles and for so prorating the cutting of existing mature stands that a future sharp production drop may be avoided.

4. The inference may be gained that so far as the western regions are concerned, volume regulation will continue to have a place in the scheme of things in connection with the development of future management programs.

From the foregoing, these conclusions may be reached: Present growth, yield, and mortality information, though possibly adequate for the purposes to which it is currently being applied, is in need of extensive and continuous checking to permit better determinations of its reliability. Perhaps the data the Regions now have and are using meets all practical requirements for initiating management in the unregulated forests of the West, but this does not seem to be proven to the satisfaction of western region planners. The permanent sample plot system, which most of the Regions contemplate, will supply the experience record that is needed and will provide a more adequate guide for the application of yield prediction techniques than is now available.

Though from a technical standpoint extreme accuracy in preducting growth, mortality, and yield may not be required for making the first steps toward management in western forests, as time passes and as cutting converts our virgin stands to a managed condition, accuracy within much finer limits than now attainable will be required. This will be true particularly if volume regulation continues to be the accepted practice. Greater tolerances of accuracy in these predictions seem acceptable if and where area regulation is used. In the West there appears, however, to be little sentiment in favor of changing from volume to area regulation systems.

From a practical point of view there is a rather impelling reason for improving growth, mortality, and yield information. The time is not too far distant in many western working circles when, as a result of private timber depletion and a concurrent increasing industrial dependence upon national forest timber, rather extreme pressures will develop for increasing the national forest allowable cut. When that time comes, our calculated cuts will be of real rather than academic importance, and we will need to be in a position to strongly defend our figures. With growth and yield figures that are more or less theoretical and unproven, it is apparent that the defense will be difficult if not impossible.

Though it appears that there is no particular advantage in insisting upon standardization of methods used in applying growth, mortality, and yield calculations as between Regions, it does seem that some advantage might be gained if there were a better understanding of what each Region is doing by the others in which similar conditions and problems prevail. This closer coordination I feel would be beneficial in the field of growth, yield, and mortality research as well as in the field of administration which applies the research findings.

S
SUPERVISION
Meetings
(Management Plan Conference)

Topic 18 - Methods Now Used in Calculating Growth, Mortality and Yield, Region 8.

A. J. Streinz

Growth

The calculation of growth or rather periodic increment expressed in terms of sawtimber volume is based upon the comparison of successive sample plot inventories. The sample plots may be permanent growth plots established for some years or sample plots taken in current timber management plan surveys.

Plot classification. Each sample plot is classified as to type and stand class. The type and stand classes should be the same as those adopted for the timber management plan survey. At least 25 sample plots are needed to give a fairly reliable estimate for a type and stand class.

1. Permanent Growth Plots

Remeasurement. The live trees on each plot are remeasured in accordance with the instructions for the plot tree tally when the plots were established. If cutting has occurred on the plot since it was established or since the last periodic remeasurement, the trees cut are recorded by species, average stump diameter outside bark, estimated DBH and merchantable length by comparison with trees of similar stump diameter bordering the cutting. The tally of the cut trees should be checked against a similar tally which should be made when the trees on the plot were marked for cutting.

Local volume tables are constructed for each species group in the respective type and stand classes. The local volume tables are based on the plot tree tallies made at the time of remeasurement and the applicable standard volume table. Differences which arise as to merchantable length due to change in utilization between inventories are accounted for by this method.

Plot volume. By means of the local volume tables and plot tallies the following plot volumes are calculated:

(1) The volume of the live trees at the time of remeasurement for each species or species group.

(2) The volume of the live trees at the time of establishment or last periodic inventory for each species or species group.

(3) The volume of the trees cut between inventories for each species or species group.

These data are tabulated. For example - -

Forest Type and Stand Class - -

| Plot | Volume 1946 | | | Volume 1936 | | | Volume cut | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | Pine | Hardwood | Both | Pine | Hardwood | Both | Pine | Hardwood | Both |
| 50 | | | | | | | | | |
| 75 | | | | | | | | | |
| 78 | | | | | | | | | |
| etc. | | | | | | | | | |
| Total-- | | | | | | | | | |

The calculation of periodic increment for a type and stand class is as follows:

(a) Method 1.

This method assumes that the plots in a given type and stand class are a representative sample of the type and stand class.

The plot volume totals as previously determined are converted to volume per acre.

The periodic increment for each species or species group and all species is calculated by means of the following equation ----

$$PI = V2 - V1 + C$$

in which

PI = periodic increment per acre
V2 = volume per acre at time of remeasurement
V1 = volume per acre at time of establishment or previous inventory
C = volume cut per acre between inventories

The periodic annual increment per acre is calculated by dividing the periodic increment per acre by the number of years between plot inventories. This figure is multiplied by the acreage of the type and stand class to obtain the periodic annual increment for the type and stand class.

(b) Method 2.

This method is based on the relationship between periodic increment per acre and timber volume per acre which may be expressed by a linear regression equation of the type - - $Y = a + b X$, in which
Y = periodic increment per acre for n years
X = timber volume per acre n years ago.

a and b are constants.

Numerical values for the constants a and b are computed by the "Least Squares Method" from the plot data.

Periodic increment per acre equations calculated from permanent plot data for the Ouachita National Forest are:

Ten-year Periodic Increment Per Acre

Shortleaf Pine Sawtimber Volume, Scribner

| Class | Equation | Number Plots |
|---|---|---|
| Virgin | $Y = 1304 + (-0.20)X$ | 104 |
| Forest Service cutover | $Y = 547 + 0.14\ X$ | 145 |
| Private cutover | $Y = 464 + 0.22\ X$ | 171 |

The periodic increment per acre equations developed by this method may be applied to individual stands, or an aggregate of stands in the type and stand class. A timber cruise will develop the average volume per acre, or X. Once this is determined, an estimate of the periodic increment can be readily determined. For example - -

(a) A timber cruise for Forest Service cutover reveals that the average volume per acre is 1650 bd.ft.

(b) The estimated 10-year periodic increment per acre is - -

$$Y = 547 + (0.14 \times 1650)$$
$$= 778 \text{ bd.ft. per acre.}$$

The periodic increment or periodic annual increment for the type and stand class is calculated as in Method 1.

2. <u>Sample Plots in Current Timber Surveys</u>

Plot tally. The following data are recorded for each merchantable sawtimber tree on a 1/5 acre circular plot, and for each merchantable cordwood tree on a 1/10 acre circular plot: Species, d.b.h. to nearest tenth inch, merchantable length, radial wood growth for 10 years, and single bark thickness on a pre-determined proportion of the sample plots to be taken in the inventory.

Local volume tables are constructed for each species or species group in the respective type and stand classes which show the volume by d.b.h. nearest tenth inch.

The relation of D.B.H. inside bark to D.B.H. outside bark is determined for each species or species group in the respective type and stand classes. This relationship should be shown by d.b.h. to nearest tenth inch in the form of a table or chart.

The present plot volume, plot volume 10 years ago, and plot periodic increment are determined as follows:

1. Prepare calculation sheet substantially as follows:

Plot volume, and Periodic Increment Calculation Sheet

Plot No.______________ Type and stand class ____________

[illegible]

Pine sawtimber 1/5 acre plot

| (1) Sp. | (2) DBH | (3) Vol. | (4) Twice R.G. | (5) DBH | (6) Vol. |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| Total | | | | | |

Col. (2) Present d.b.h. to nearest tenth inch
Col. (3) Present volume
Col. (5) Estimated DBH to nearest tenth inch n years ago
Col. (6) Estimated volume n years ago

(a) For each tree on the plot tabulate the following data: species, column (1); present d.b.h. to nearest tenth inch, column (2); present volume as read from local volume table, column (3); and twice radial wood growth for past 10 years, column (4).

(b) Determine for each tree on the plot its estimated d.b.h. to nearest tenth inch 10 years ago and record in column (5). From the table or chart constructed to show the relation of d.b.h. inside bark to d.b.h. outside bark read the present d.b.h. inside bark, subtract twice the radial wood growth for past 10 years to obtain d.b.h. inside bark 10 years ago, then read from chart or table the corresponding d.b.h. outside bark 10 years ago.

(c) Determine for each tree on the plot its estimated volume 10 years ago by reference to the local volume table and record in column (6). If the tree was below sawtimber size 10 years ago, it will have no sawtimber volume to record in column (6).

(d) Add columns (3) and (6) to obtain present plot volume and plot volume 10 years ago. The difference between them is the plot periodic increment for 10 years.

From this point on the procedure is the same as described for permanent growth plots.

The equations developed by the correlation of periodic increment and timber volume may be improved for estimation of growth by correlating periodic increment with other stand characteristics as has been done by Jesse H. Buell in the Prediction of Growth in Uneven-aged Timber Stands on the Basis of Diameter Distributions. Duke University School of Forestry Bulletin #11 1945, and Allyn M. Herrick in Multiple Correlation in Predicting the Growth of Many-Aged Oak-Hickory Stands. Journal of Forestry November 1944. It is planned to analyze the existing sample plot data in this Region for this purpose and to determine the possibilities of the determination of equations for general application as well as local application.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

## Mortality

Many of the permanent plots in this Region were established to provide data on mortality as well as growth. However, our past interest in mortality has lessened considerably by the adoption of the method for estimation of growth as already described which automatically accounts for mortality. Then estimation of mortality is of less importance because conditions permit the adoption of short cutting cycles and changes in cutting plans to salvage mortality.

## Yield

The regional yield tables such as "Volume, Yield, and Stand Tables for Second-Growth Southern Pines" U.S.D.A. Miscellaneous Publication No. 50 September 1929; "Volume, Yield and Growth of Loblolly Pine in the Mid-Atlantic Coastal Region USDA Forest Service Appalachian Forest Experiment Station April 1939; and several local yield tables have not been used to any extent for estimation of yield. Probably the estimation of yield will continue to be made on the basis of the data from plots as described under growth, and the comparison of successive inventories and cutting records for entire separate stands, or land subdivisions such as compartments.

## Accuracy of Prediction of Growth, Mortality and Yield.

The current predictions of growth, mortality and yield for timber management plans in Region 8 are adequate, whatever the accuracy expressed in numerical terms. Forest practice is primarily the task of conducting intermediate cuttings. Regulation of cut is reduced to the determination of the period or cutting cycle after which the compartments subjected to intermediate cuttings will support another round of cuttings. Other factors such as changes in utilization practice, markets, and volume demanded by logging operations, character of the stands, are of greater weight in the determination of the period of return to a compartment than growth predictions.

The permanent plot data for the Ouachita indicate volume growth can be estimated from volume per acre as expressed by the regression equations with the following standard errors:

| Class | Standard Error |
|---|---|
| Virgin | 28% |
| Forest Service cutover | 9% |
| Private cutover | 10% |

Herrick working with permanent plot data in many-aged Oak-Hickory stands found volume growth per acre can be estimated from growing stock, number of stems, and growth in d.b.h. with a standard error of $\pm$ 14%.

Buell working with permanent plot data in uneven-aged timber stands in Southern Appalachians found volume growth per acre can be estimated from number of trees per acre, sum of diameters per acre, and sum of diameters squared per acre with the following standard errors:

| Class | Standard Errors | | | |
| --- | --- | --- | --- | --- |
| | M. | I. | S. | N. |
| Old growth all types | 10% | 6% | 4% | 10% |
| Second-growth | | | | |
| Short-rotation oaks | 19% | 10% | 7% | 11% |
| Long-rotation oaks | 40% | 35% | 23% | 85% |
| Core hardwoods | 23% | 20% | 20% | 17% |
| Pine and hardwoods | 30% | 30% | 8% | 12% |

M = mortality  I = ingrowth  S = survivor growth  N = net growth

## Cost

The current cost in Region 8 for the establishment of a system of permanent sample plots to serve the dual purpose of obtaining periodic estimates of timber volume and increment in the future as well as the current estimate of timber volume and increment ranges from $4.35 to $7.24 per plot for field work, and from $0.91 to $1.68 per plot for office compilation of estimates and increment. Current costs for remeasurement and compilation of periodic increment equations for permanent plots established for 10 years range from $3 to $4 per plot.

S
SUPERVISION
Meetings
(Management Plan Conference) March 15, 1949

METHODS OF MANAGEMENT AND METHODS OF REGULATION OF CUT
WESTERN WORKING CIRCLES

Topic 19

Austin A. Hasel
Region 5

Sawlogs constitute the principal product sought in the management of timber cropland in California. Management for other products such as poles and piling, and Christmas trees is confined to limited areas, or is secondary to sawlog production.

The order of preference by species in the pine-fir types is sugar pine, ponderosa pine, Douglas fir, red fir, white fir and incense cedar. The most valuable types are ponderosa pine--sugar pine, ponderosa pine--Jeffrey pine, and sugar pine--white fir. In the mixed types, if Douglas fir and the true firs are not too strongly in the ascendancy, attempts are made to increase the proportion of pine among potential crop trees and in the reproduction.

Silvical Characteristics of Main Species

Pines. Ponderosa pine and sugar pine are intolerant species. They require exposed mineral soil for germination and partial shade for best seedling survival. After establishment they grow best in the open. Seed crops occur irregularly at intervals averaging 4 to 5 years. The rodent population usually takes a sizeable "cut" out of the crop. Good seedbed conditionsas left immediately after logging, late spring rains, and freedom from hard frosts after germination are essential conditions for natural regeneration. Due to scant rainfall from June until October, seedlings must get their roots down 18 to 20 inches early in the first season.

Young pines competing with white fir in partial shade steadily lose ground. Even in the open, cultural measures are advisable to assure dominance of sugar pine over white fir of equal size. Ponderosa pine can be counted upon to hold its own in the open.

Ponderosa pine grows in extensive pure stands on the lava plateau of northeastern California. It tends in nature to approximate the diameter class structure of the selection forest. For areas of 20 to 30 acres or larger, the number of trees plotted over diameter tends to give a shape of curve that is characteristic of selection forests. The arrangement of stems on the ground is typically in irregular, usually small, even-aged groups. This explains why a minimum area of 20 acres is required before the selection stand diameter distribution becomes apparent. The adoption of some form of partial cutting such as group selection,

therefore, appears to be appropriate for this species. Clear cutting by small even-aged groups is more favorable to natural regeneration than either clear cutting or single tree selection.

Sugar pine does not occur in pure stands. Where it forms an important element of the type, it shows the same groupwise distribution as ponderosa pine.

The chief cause of mortality in ponderosa and Jeffrey pine is attack by bark beetles (Dendroctonus). There may be a chain of causes, but at least bark beetles deliver the final blow. Susceptibility of mature trees to bark beetle attack is closely correlated with tree vigor. This is not true with sugar pine, as it appears that thrifty trees are as likely to be attacked as slow-growing trees.

High susceptibility to blister rust constitutes a major threat to successful future management of sugar pine. The economic and silvicultural considerations involved in Ribes eradication and the cultural work needed to maintain sugar pine are currently being investigated to delimit the areas on which sugar pine is to be favored.

Other species. On most California sites, Douglas fir is more tolerant than the pines. Incense-cedar and the true firs are definitely tolerant species. Seed crops of these species occur at shorter intervals than with pine, are not harvested as efficiently by rodents, and are dispersed over a wider radius from seed trees. Although mineral soil is favorable to germination, it is not as essential as with pine. Seedling establishment continues gradually but steadily, even under brush and hardwoods. Once the brush is overtopped, Douglas fir and the true firs make rapid growth and shade out the brush.

Seedling mortality is very high in incense-cedar, but once established, they persist well in competition. Incense-cedar is seldom dominant or of equal height compared with competing species.

Douglas fir and the true firs occur both in even-aged stands and in all-aged stands. They are easier to manage and maintain in the stand than the pines.

Present Management Methods

In virgin stands it is assumed that growth and mortality tend to balance and net growth is zero. The initial objective of management is to put these areas into productive condition as rapidly as possible by making cuts that are confined to removal of poor-risk trees if profitable. By a poor-risk cut that removes 15 to 25 p rcent of the volume, the heavy reserve stand makes good growth of high quality as long losses are effectively controlled. Following the poor-risk cutting the over-mature, slowest-growing trees are cut, together with some of the large-limbed dominants that are crowding trees of better form and quality.

Road costs are taken out of stumpage at the present time. This factor largely governs whether the above cuts are made separately or at one time. The order of cut by compartments or logging units is tied to a logical road development program for the area as a whole that includes consideration of road costs, current markets for the less desirable species, and the relative threat of mortality in different areas.

Cruise data are compiled in the form of species-tree class structure tables by sites for management plan purposes. Poor-risk trees are segregated also. The Dunning system of tree classification is used, which groups trees into 8 classes that are based on relative vigor, age class, crown class, and crown size. Poor-risk trees include those whose chances of surviving until the second cutting cycle are deemed poor. The element of personal judgment is a factor in rating risk.

Growth is predicted on the basis of cutting (a) only poor-risk trees and (b) poor-risk trees plus all overmature trees that are merchantable. The annual cut allowed during the period of removal of poor-risk and overmature elements of the stand usually averages around one and one-half times the annual net growth of the reserve stand.

At present, the Dunning alignment chart method is applied in predicting growth. Predictions are made separately for gross growth, ingrowth, and mortality--all species combined. The variables that enter into this growth prediction include reserve volume, proportion of volume in sugar pine and white fir, proportion of volume in the various tree classes, site index, average volume per tree, and number and average diameter of poles. These statistics are provided by the species-tree class structure tables mentioned above. The predictions are on an average annual basis for a 20-year period.

The mortality estimates usually look discouraging. The permanent plots on which the prediction mechanism is based were established in many cases as far back as 1910. The average annual mortality on these plots for the first 20 years was over 80 board feet per acre. Mortality for the next 15 years was a little greater than was predicted. In pure ponderosa pine on the Blacks Mountain Experimental Forest losses have been reduced 80 percent by light poor-risk cutting compared to losses in adjacent virgin stands. This much reduction of loss in present cutting compared to old cutting cannot be expected, but what it amounts to is subject to considerable difference of opinion. In recent years many dead trees have been logged and it appears that this may become an important factor in coming closer to realizing a larger proportion of gross growth as net growth. In making up the cutting budget it seems desirable to state the cut in terms of relationship to net growth and show separately the expected volume of salvageable mortality.

According to present plans, the allowable cut after the whole area has been cut over once, must not exceed net growth. No detailed specifications are set up as to the type of marking that will be done beyond the first cutting cycle. It is likely that tree class marking rules will be given less emphasis and end objectives in managing the growing stock will be stressed, with considerable latitude allowed to the forester on the ground.

Permanent mortality and growth plots are currently being established after logging, or as far ahead of logging as resources permit. These will be remeasured at 10-year intervals for growth, and perhaps oftener for mortality. Analysis of these data, together with Forest Survey plot data that are additive to ours, will provide local data for plan revision prior to the second cutting cycle.

Present plans provide for the setting aside of K-V money for stand improvement work, and in some instances for planting in case natural restocking is not secured within 4 years following logging. Provision is made for disposal of

sanitation trees, snags, and the handling of brush. Included also are provisions for fire protection, elimination or control of grazing during critical periods in regeneration, reservation of areas for recreation, dedication of areas to game cover, and control of erosion and protection of stream channels. These provisions are prepared in collaboration with, or are reviewed by, the personnel concerned in the Regional Office. These other-use phases require further study so that provisions can be made more specific.

Recommended Future Action

Regeneration. Plans should in all cases provide for aggressive action directed to maintenance of at least the degree of stocking that is obtained in the virgin stand. On cut over areas where much ground control has been lost, measures should be taken to recapture it. Every tree cut releases soil that will be (a) utilized by nearby trees or advance young growth that thereby make accelerated growth, (b) restocked by desirable trees, or (c) lost to other vegetation that is likely to consist of worthless shrubs.

Opportunity should be taken to cut so as to take full advantage of seed crops and create openings of suitable size with seedbed conditions favorable to establishment of desirable reproduction. Seed-eating rodents should be poisoned at the same time. If natural restocking is not successful within two years following logging, either the soil surface should be scarified prior to the fall of a seed crop or, if there is no seed crop, direct seeding should be done. Rodents should again be poisoned. Another alternative is to plant. This work should be initiated on the most favorable sites and most critical areas first, until successful techniques are established. Roads and skid trails which will be used recurrently should be levelled at intervals if necessary to minimize erosion, but should not be planted. In some cases seeding to grass may be desirable. These measures should be taken following any cutting that creates unstocked openings that add up to worthwhile acreage, and not deferred until the second cutting cycle. Maintenance of ground control, and healthy soil, is more important than regulation of growing stock if a choice must be made.

Balanced stand structure. For the main timber types and sites, tables or curves should be prepared showing the number of trees needed by diameter class to insure regularity of yield at a reasonably high level. In selection stands, or group selection stands, this means that the number of trees decreases in geometric progression with increase in diameter. This relationship will plot as a straight line on semilogarithmic graph paper. These tables or graphs are needed to serve as standards against which to measure progress or regress in manipulating the growing stock.

The approach to preparation of such curves raises the question of whether normal yield tables for even-aged stands can be adapted to selection stands, or whether the procedure used in specifying the balanced growing stock in the method of control based on the continuous inventory system should be used. Since we are concerned primarily with pine species that, according to earlier statements are adapted to even-aged management by small, irregular groups, it seems that the use of yield tables is safe. A possible drawback to this

is that we will be treating trees of a given diameter as of yield table age, whereas they may have been suppressed and actually be much older. It has been observed, however, that suppressed ponderosa pine seedlings, whip-like and crooked, have recovered on average sites and become thrifty and straight following release.

The yield table method may be illustrated by its use in the plan for the Blacks Mountain Experimental Forest. The normal yield tables for ponderosa pine prepared by Walter Meyer were used, interpolating for the site quality involved and discounting to 80 percent of normal stocking. A 20-year cutting cycle was assumed. On the basis of these yield tables, the average annual growth by different rotations was as follows:

| Rotation | Average annual growth per acre in board feet |
|---|---|
| 120 | 136 |
| 140 | 144 |
| 160 | 146 |
| 180 | 145 |
| 200 | 143 |

On the basis of average annual growth alone, the 140-year rotation is indicated. With this rotation and 20-year cutting cycles, the average acre of an ideal stand just prior to cutting would have 1/7-acre in each age class from the 20-year to the 140-year, inclusive. Table 1 shows the number of trees and volume in such a stand, using 80 percent of normal yield table values.

The balanced structure of such a stand is indicated by one of the curves in Figure 1, where it is shown that the number of trees decreases in geometric progression with increase in diameter. Such a stand structure would insure sufficient trees in the 120-year age class to replace in 20 years the cut on the 1/7-acre in the 140-year age class. After each cut, 1/7-acre would need to be restocked promptly. The volume cut per acre would be 2,887 board feet. The diameter of the average tree would be 16.2 inches for trees 11.6 inches d.b.h. and over, and the largest tree would be 26 to 30 inches in diameter.

The stock chart, Figure 2, shows volume over diameter for the virgin stand, and the hypothetical regulated stand before and after the periodic cut. The problem of removing the excess growing stock by successive stages while building up stocking in the smaller diameters provides a real challenge to the forester on the ground. On this area the advance growth, if saved in logging, already stocks the area 57 percent on the basis of one or more seedlings or saplings per milacre. The problem is to promote growth on these and larger trees up to, and including, the 18-inch class so as to build up the deficient classes.

Table 1.- Regulated selection stand based on yield tables for even-aged stands[1/]

| D.B.H. | AGE CLASS 20 | | 40 | | 60 | | 80 | | 100 | | 120 | | 140 | | ALL CLASSES | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T[2/] | V[3/] | T | V | T | V | T | V | T | V | T | V | T | V | T | V |
| 1 | 194 | - | 26 | - | 1 | - | - | - | - | - | - | - | - | - | 221 | - |
| 2-3 | 94 | - | 77 | - | 16 | - | 3 | - | 1 | - | 0+ | - | - | - | 191 | - |
| 4-5 | 36 | - | 48 | - | 29 | - | 10 | - | 3 | - | 1 | - | 1 | - | 128 | - |
| 6-7 | 2 | - | 25 | - | 23 | - | 14 | - | 7 | - | 3 | - | 2 | - | 76 | - |
| 8-9 | | | 8 | - | 13 | - | 11 | - | 7 | - | 5 | - | 3 | - | 47 | - |
| 10-11 | | | 2 | - | 7 | - | 8 | - | 6 | - | 5 | - | 3 | - | 31 | - |
| 12-13 | | | 0+ | 15 | 3 | 166 | 4 | 372 | 5 | 396 | 4 | 354 | 3 | 292 | 19 | 1595 |
| 14-15 | | | 0+ | 6 | 1 | 111 | 2 | 299 | 3 | 430 | 3 | 451 | 3 | 416 | 12 | 1713 |
| 16-17 | | | 0+ | 2 | 0+ | 34 | 1 | 159 | 2 | 390 | 2 | 525 | 2 | 523 | 7 | 1639 |
| 18-19 | | | | | 0+ | 7 | 1- | 66 | 1 | 249 | 1 | 435 | 1 | 525 | 4 | 1282 |
| 20-21 | | | | | | | 0+ | 16 | 0+ | 112 | 1 | 304 | 1 | 484 | 3- | 916 |
| 22-23 | | | | | | | 0+ | 6 | 0+ | 46 | 0+ | 159 | 1 | 326 | 2- | 537 |
| 24-25 | | | | | | | 0+ | 1 | 0+ | 16 | 0+ | 73 | 0+ | 188 | 1- | 278 |
| 26-27 | | | | | | | | | 0+ | 3 | 0+ | 28 | 0+ | 95 | 1- | 126 |
| 28-29 | | | | | | | | | | | 0+ | 7 | 0+ | 32 | 0+ | 39 |
| 30-31 | | | | | | | | | | | | | 0+ | 6 | 0+ | 6 |
| Total | 326 | - | 186 | 23 | 93 | 318 | 54 | 919 | 35 | 1648 | 25 | 2336 | 20 | 2887 | 743 | 8131 |

1/ "Yield of even-aged stands of ponderosa pine" by Walter H. Meyer. Technical Bulletin No. 630, U.S.D.A., October 1938.
With a 140-year rotation and 20-year cutting cycle the average acre was assumed to include 1/7-acre in each age class, 80 percent normal stocking, site index of 72 feet based on dominants at 100 years.

2/ Number of trees.

3/ Board foot volume by Scribner Rule.

Figure I— STAND DISTRIBUTION CURVES

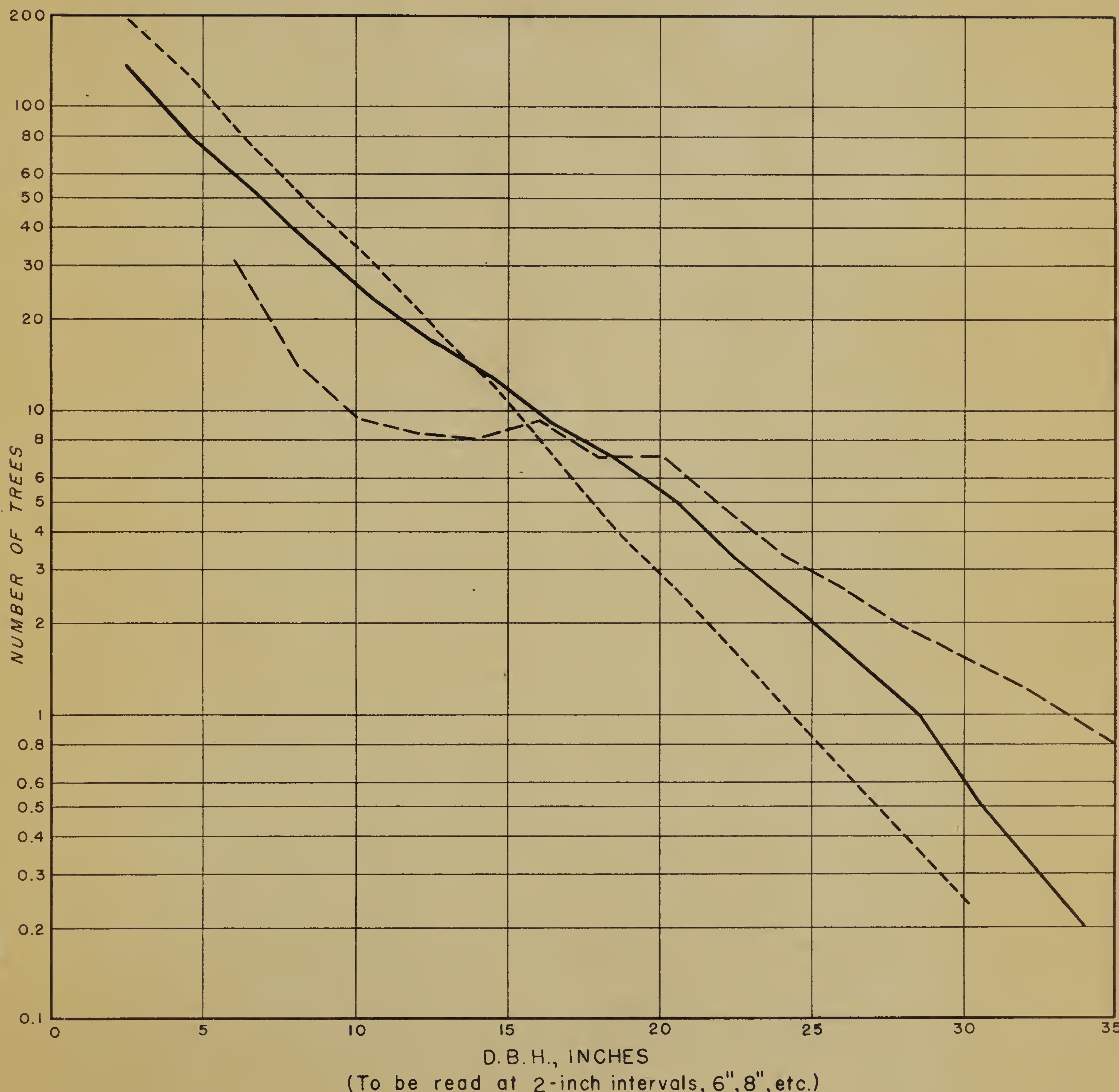
Regulated selection stands, 80 percent of normal stocking, based on Meyer's yield tables for even-aged stands of ponderosa pine:

---- 140-year rotation, 20-year cutting cycle

—— 200-year rotation, 20-year cutting cycle

Forest of Couvet, Switzerland:

— — Selection stand managed under continuous inventory



Under the older, heavy type of Forest Service cutting that took 75 to 85 percent of the volume, and on most private cutting, the 140-acre rotation and the goal of balanced stand structure as shown in Figures 1 and 2 appears reasonable. Long in the future it can be decided whether to grow selected trees to larger size. Quality would have to be obtained largely by the pruning of crop trees.

In future treatment of virgin stands, or in lightly cut stands, however, it seems questionable whether we should plan on practically starting over again with young, thrifty trees. Why not make use of the large-tree growing stock that nature has built up during the past 300 or 400 years and manipulate it so as to continue on a basis comparable to a 200- or 240-year rotation? This can certainly be done if losses can be controlled. Roads built during the first cutting cycle will have to be maintained. Having roads, poor-risk trees can be harvested whenever sufficient volume builds up and snags can be salvaged before they deteriorate too far. While the ring width is narrow on large mature pine, the volume growth and value growth is good. Large logs with narrow rings produce the quality of lumber that enables ponderosa pine to compete in lumber markets throughout the country.

Meyers' yield tables which extend to 200 years were used to provide the frequency distribution by diameter shown for the 200-year rotation in Figure 1. With the same 20-year cutting cycle this means that only 1/10-acre would need to be restocked following each periodic cut, compared to 1/7-acre under the 140-year rotation. It was shown previously that average annual growth would be changed very little compared to the 140-year rotation. At Blacks Mountain the gross growth in the virgin stand is estimated to be 127 board feet per acre per year. This is reasonably close to growth expected for 80 percent normal stocking, and shows that the crux of the problem is to come close to realizing gross growth as net growth, i.e., control losses.

The adoption of a longer rotation by making less of a radical change in the virgin stand suggests comparison with the continuous inventory system of guiding management as used in certain forests in Switzerland and other parts of Europe. If these forests are truly selection forests they should tend to the balanced stand structure such as has been shown for hypothetical regulated stands. To make a comparison, data for the communal forest of Couvet were taken from Table 1 of an article by H. C. Biolley entitled "Straight Thinking about the Continuous Inventory System", translated for the Southern Station by R. E. Worthington in 1935. The plotting of number of trees over diameter is shown in one of the curves of Figure 1 for the year 1926. Biolley's article is directed mainly to answering criticisms to the effect that this forest was mainly even-aged, rather than all-aged, and that there was a great deficiency in the younger age classes or smaller diameters.

The curve in Figure 1 indicates that there is a deficiency in number of trees below 20 inches on the basis of trend of number of trees over this size. It is possible that by cultural work in developing a higher proportion of crop trees from these smaller sizes that the balanced structure may be maintained in the larger trees. At any rate the structure does not deviate very much from what would be obtained at Blacks Mountain if a longer rotation were possible, reducing the number of small trees and increasing the number of large trees.

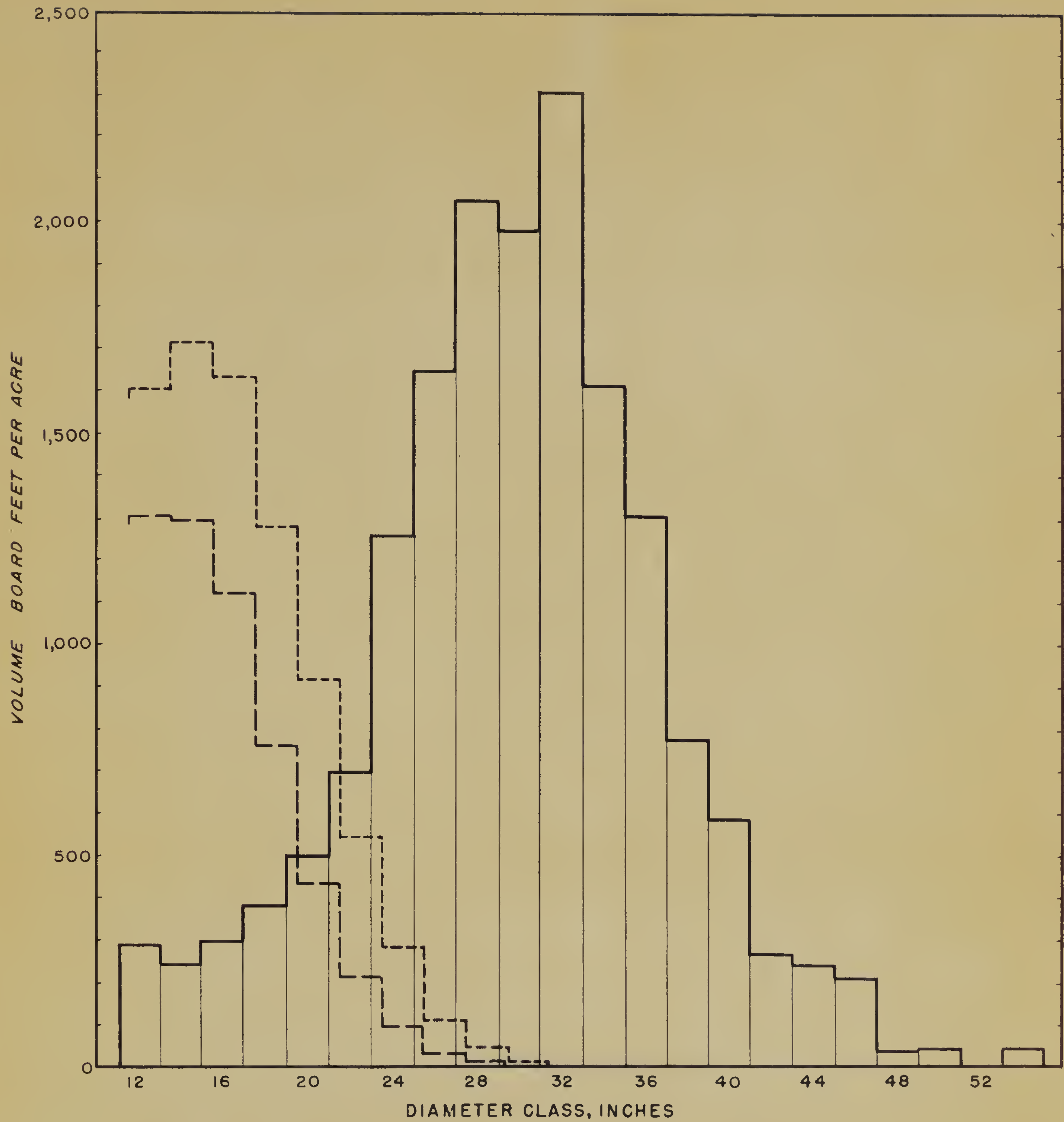



Figure 2 — STOCK CHART

PONDEROSA PINE - BLACKS MOUNTAIN EXPERIMENTAL FOREST

——— Present stocking - 16,811 board feet per acre

- - - - Stocking at end of 140-year rotation — 8,131 bd. ft. per acre

— — Reserve volume after periodic cut — 5,244 bd. ft. per acre

Periodic cut, 20-year cutting cycle — 2,887 bd. ft. per acre

Inventory. The charts of balanced stand structure are intended as guides to what should be accomplished on the ground. Once the permanent plots are established and remeasured over the working circle, the data will be in hand for judging the growing stock situation in a broad way by types and sites. Prior to the second and succeeding cutting cycles in each sale area or compartment, a more detailed inventory will be needed. Under the continuous inventory system, a complete inventory is made periodically in European forests. This intensity is not contemplated here. Rather, it would seem possible to obtain the essential information by sampling and do it cheaply. Plotting the number of stems by diameter and comparing with the balanced distribution would provide guidance to marking to insure that the growing stock volume gradually approaches the normal volume. If the present volume is less than the normal growing stock, the cut should be less than growth. If there is an excess of growing stock the cut should exceed growth by an amount that depends upon the length of period of conversion. In no case should trees be cut if they are needed to fill up classes in the balanced stand. For this reason care must be taken in including ingrowth in allowable cut, as in some cases this may result in an overcut in trees of merchantable size.

The sample plots or strips established prior to cutting should be staked at that time and rerun after logging to determine the net reserve stand, and to provide the information needed in planning the stand improvement and restocking programs. These permanent strips should be used to measure change over time, compartment by compartment, so that the forester in charge can be kept currently informed as to the efficacy of treatments. By so doing, indicated changes can be made while trends are still reversible. Inspectors and researchers would study these results and direct their attention accordingly.

AUSTIN A. HASEL

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

ADDRESS REPLY TO
DIRECTOR
AND REFER TO

RS
MENSURATION
Growth
Selection Stands

UNIVERSITY OF CALIFORNIA
~~330 GIANNINI HALL~~
BERKELEY, CALIFORNIA

December 7, 1948

Definition of Variables

Following are the definitions of variables used in the growth and loss alignment charts for selection stands. The definitions are segregated by charts.

GROWTH OF STAND 11.6 INCHES DBH AND OVER.

A. Volume per acre, board feet. The volume per acre, by Scribner Rule, of all trees that were 11.6 inches DBH and over at the beginning of the period of estimate. All species included.

B. Percent of volume in sugar pine and white fir. The volume of sugar pine and white fir in trees 11.6 inches DBH and over, expressed as a percentage of the volume of all species, in trees 11.6 inches and larger.

C. Average volume per tree, board feet. Volume of all trees 11.6 inches DBH and over, divided by the number of trees 11.6 inches DBH and over. All species included.

D. Percent of volume in tree class 1. Volume of trees 11.6 inches DBH and over that are in Region 5 tree class 1, expressed as a percentage of volume in all trees 11.6 inches DBH and over. All species included.

G. Site index, feet. The average total height, in feet, of mature dominant (Class 3) trees in the stand. Reference is made to California Forest and Range Experiment Station Research Note No. 28, December 1, 1942.

X. Mean annual growth per acre, board feet. Average annual growth per acre in board feet, Scribner Rule, of all trees that were 11.6 inches DBH and over at the time of cutting. Twenty year period.

TREES GROWING INTO THE STAND 11.6 INCHES AND OVER.

A. Number of poles 3.6 to 11.5 inches DBH, per acre. Number of trees per acre, from 3.6 to 11.5 inches DBH, inclusive, at the beginning of the period of estimate. All species.

B. Percent of poles in sugar pine and white fir. Number of sugar pine and white fir trees 3.6 to 11.5 inches DBH expressed as a percentage of the number of trees of all species 3.6 to 11.5 inches DBH.

C. Percent of poles in tree class 1. Number of trees 3.6 to 11.5 inches DBH that are in Region 5 tree class 1, expressed as a percentage of all trees 3.6 to 11.5 inches DBH.

D. Average diameter of pole stand, inches. Average diameter of all trees 3.6 to 11.5 inches DBH, by basal area method. It will be sufficiently accurate to use the average of the diameters in application of the chart.

G. Site index, feet. The average total height, in feet, of mature dominant (Class 3) trees in the stand. Reference is made to California Forest and Range Experiment Station Research Note 28, December 1,1942.

X. Average annual growth per acre, board feet. Volume by Scribner Rule, of the poles at the time they reach 11.6 inches DBH, plus subsequent growth, during a 20-year period, converted to an acre-year basis.

LOSS IN STAND 11.6 INCHES DBH AND OVER.

A. Volume per acre, board feet. The volume per acre, by Scribner Rule, of all trees that were 11.6 inches DBH and over at the beginning of the period of estimate. All species.

C. Percent of volume in white fir. Volume of white fir in trees 11.6 inches DBH and over expressed as a percentage of the volume of all species, trees 11.6 inches DBH and over.

D. Percent of volume in tree classes 4, 5, 6, and 7. Volume of trees 11.6 inches DBH and over that are in Region 5 tree classes 4, 5, 6, and 7, expressed as a percentage of the volume in all trees 11.6 inches DBH and over.

E. Site index, feet. The average total height, in feet, of mature dominant (Class 3), trees in the stand.

X. Mean annual loss per acre, board feet. Volume by Scribner Rule, of all trees 11.6 inches DBH and over that died during a 20-year period. Converted to an acre-year basis.

In computing values for these variables, to be applied to the charts, it is necessary to work with a total value for all plots. That is, suppose 50 plots from a common site or type are to be used in making a prediction. The volume, number of trees, etc, from the 50 plots should be totaled. The values for the variables must be computed from these totals and then converted to an acre basis where necessary. Errors will result if each plot is converted to an acre basis and the variables are derived from these converted values.

V. A. Clements

V. A. CLEMENTS,
Associate Silviculturist

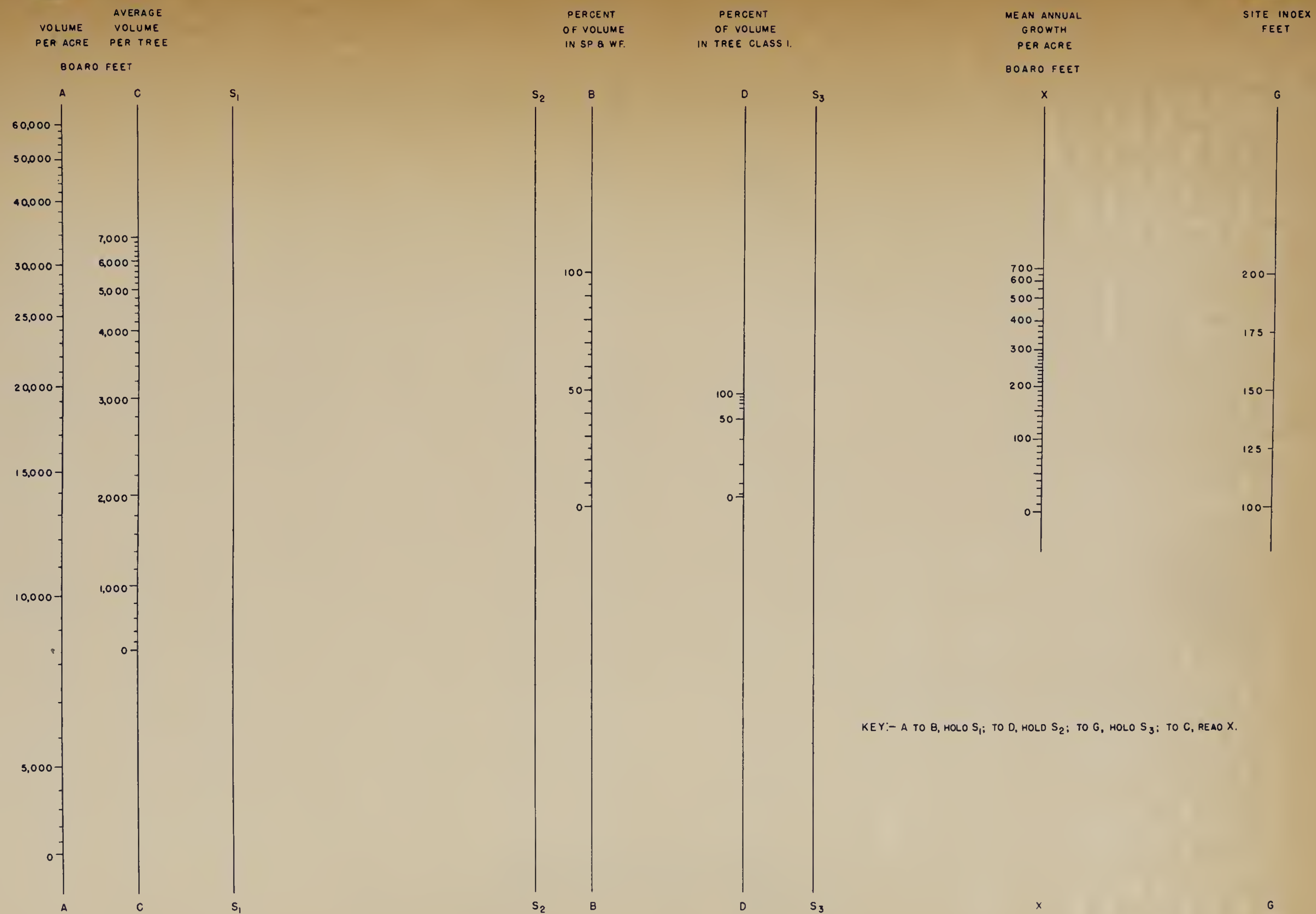



CHART FOR ESTIMATION OF GROWTH
IN SELECTION FORESTS OF THE SIERRA NEVADA

# STAND 11.6 INCHES DBH AND OVER

BOARD FEET 1939 SCRIBNER RULE

PREPARED BY V A CLEMENTS
DIVISION OF FOREST MANAGEMENT
R 5
Mensuration
Stand Studies
Growth
Selection Stands

Correlation 25

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
E. I. KOTOK — DIRECTOR

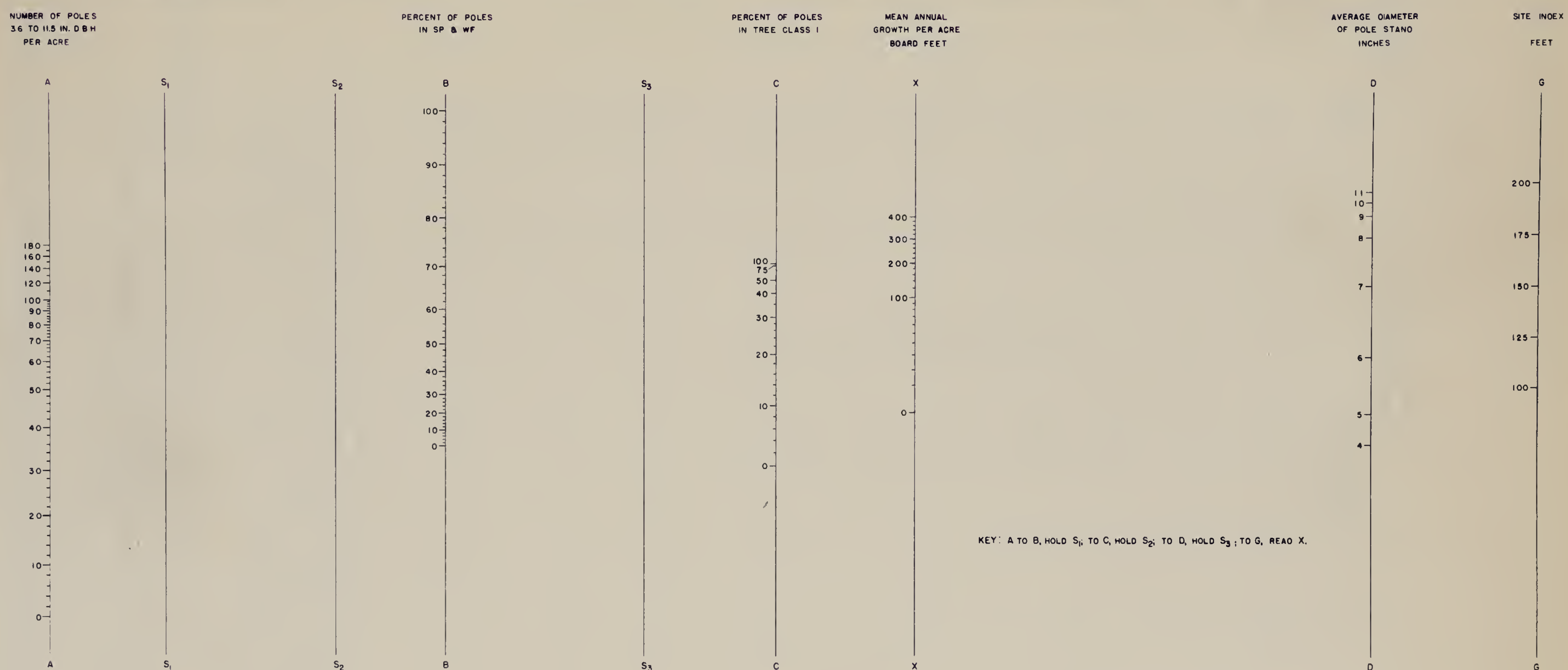



CHART FOR ESTIMATION OF GROWTH
IN SELECTION FORESTS OF THE SIERRA NEVADA

## TREES GROWING INTO THE STAND 11.6 INCHES D.B.H. AND OVER

BOARD FEET 1939 SCRIBNER RULE

PREPARED BY V. A. CLEMENTS
DIVISION OF FOREST MANAGEMENT
RS
Mensuration
Stand Studies
Growth
Selection Stands
Correlation 6

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
E. I. KOTOK—DIRECTOR

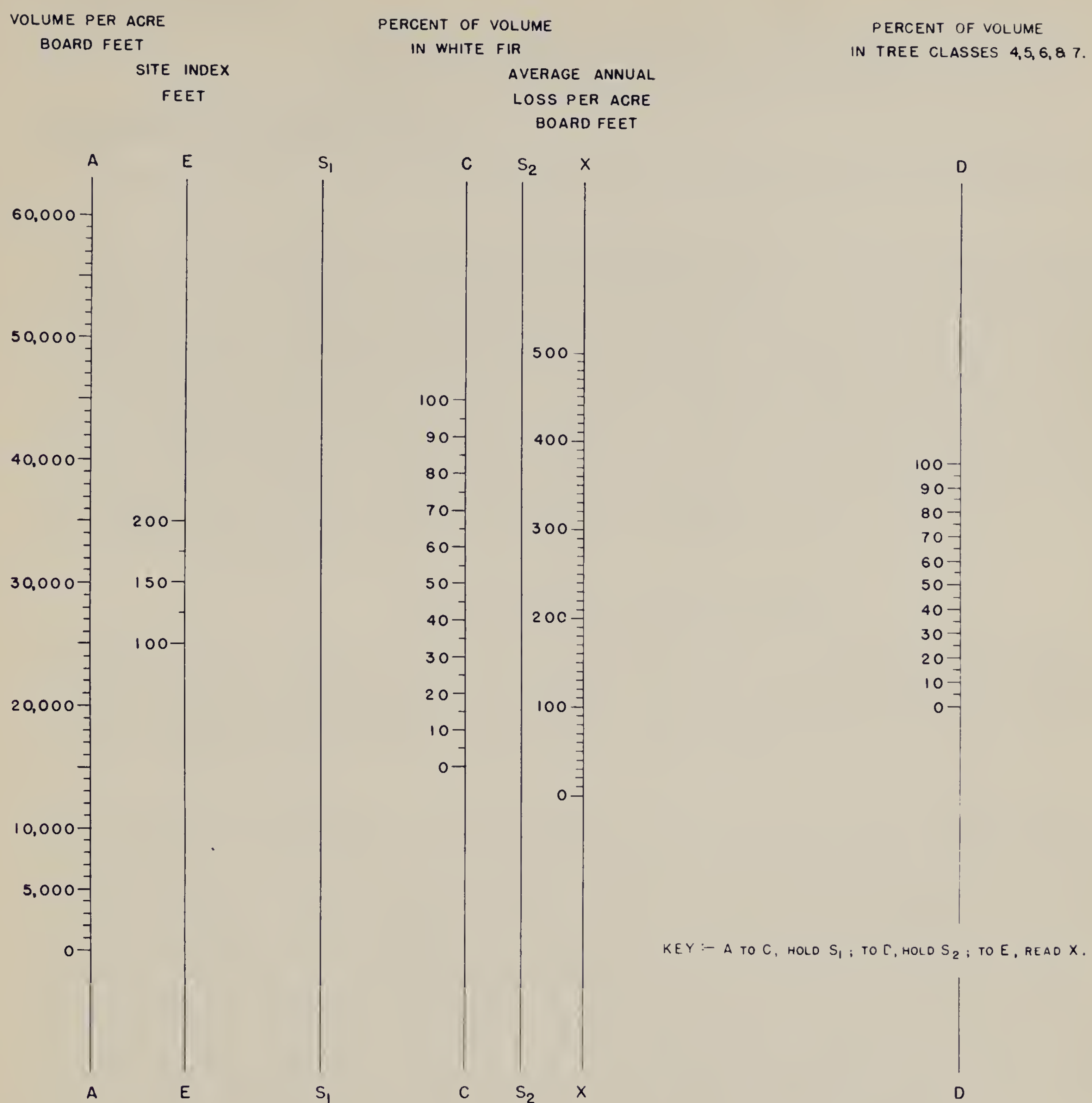



CHART FOR ESTIMATION OF LOSS
IN SELECTION FORESTS OF THE SIERRA NEVADA

# STAND 11.6 INCHES DBH AND OVER

BOARD FEET 1939 SCRIBNER RULE

PREPARED BY V. A. CLEMENTS
DIVISION OF FOREST MANAGEMENT
RS
Mensuration
Stand struc
Growth
Selection Stands

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
E. I. KOTOK — DIRECTOR

S
PLANS - R-2
Timber Management

March 21, 1949

MANAGEMENT PLAN CONFERENCE - TOPIC #19

Management of Lodgepole Pine

by Bert Lexen, Rocky Mountain Forest and Range Experiment Station

Only on a few areas is intensive management of lodgepole pine possible at present. The lack of an adequate transportation system precludes the development of detailed management plans. Moreover, larger quantities of submerchantable material in commercial stands, for which there is now only a small and intermittent market, further complicates the problem. Realistic cutting budgets are almost impossible to draw up because the planner is in no position to say how much of the small, low-vigor material can be sold in the future. The ability to dispose of both large and small trees is important, if the objectives of management are to be achieved. This will be demonstrated by a hypothetical example later.

## Silvicultural Considerations

Lodgepole pine, like most pines, is intolerant. It regenerates and develops rapidly under full sunlight, and tends always toward evenage. Seedlings become easily established under shade, but soon die or develop into ill-formed specimens when they are too heavily shaded.

Successful regeneration requires the removal of at least 60 percent of the merchantable volume. Experience has shown, however, that while regeneration is successful, following a partial cut of 60 percent, wind damage to the reserve stand is so great by this method of cutting, that its use is discouraged. Experimental cuttings of different intensities of selective cutting on the Fraser Experimental Forest indicate a mean annual mortality of 134 board feet for 4 M board feet reserve stands, and 90 board feet for 6 M board feet stands. These mortality losses are for a 7-year period directly after cutting and are, therefore, probably high. They do point out, nevertheless, the losses which the reserve stand must sustain when heavy to moderately heavy selective cutting is employed.

The exceptionally heavy mortality obtained in the lodgepole pine type is largely the result of strong spring winds that come at a time when the ground is made soft by melted snow. The poor root development, which results from the many stems per acre so common with lodgepole pine, also contributes to heavy mortality, but, regardless of the cause, it has become apparent that lodgepole pine can best be managed on an even-aged basis.

## Stand-Condition Classes

Two important condition classes occur in commercial stands of lodgepole pine. They are even-aged stands 200 to 250 years old, and broad-aged stands in which the merchantable stand is also approximately 200 to

250 years old, but contains, in addition, a scattering of young trees. The factors which have led to the development of each condition class are of interest silviculturally, but for management purposes it is only important to know that for even-aged stands, the submerchantable portion of the growing stock is composed almost completely of small-crowned, low-vigor trees of the same age as the main stand. Because of this condition, complete clear cutting is always necessary. Broad age stands, on the other hand, contain a light residual of young, vigorous, sub-merchantable trees that can become the nucleus of two or more future cuts, provided precautions are taken to protect these trees from wind.

## Cutting System

Lodgepole pine can be easily adapted to clear cutting in groups, or some form of strip cutting. The latter system of cutting is preferred because it provides better control over successive cuts, reduces logging damage, and simplifies future logging operations.

Strip cutting can be of several types, the simplest form of which is alternate clear strip cutting. This is perhaps the least desirable of the strip cutting methods because the cutting cycle for it is long (one-half the rotation). Wherever possible, it is desirable to use multiple clear strip cutting which reduces the cutting cycle by the number of strips which must be cutover to completely harvest the timber from a unit of area. For example, if cutting is completed in three strips, the cutting cycle is equal to $\left(\frac{\text{rotation}}{3}\right)$, and if four strips are used, the cutting cycle is equal to $\left(\frac{\text{rotation}}{4}\right)$. The use of more than four strips leads to over refinement of management.

## Regulation of the Cut

### Even-aged Stands

The regulation of the cut under the three-strip system is illustrated by the following hypothetical example in even-aged lodgepole pine. The growing stock is assumed to be 12 M board feet per acre, which is in excess to that needed for high level sustained yield. The problem is to convert a forest with an excess of growing stock to one in which the growing stock is approximately normal; this goal to be achieved by cutting approximately the same volume annually.

The successive steps to be followed in the conversion of a virgin, unmanaged stand to one with a normal growing stock is shown in Figure 1. Strips are 150 to 180 feet wide, and the rotation, 120 years. The cutting cycle is, therefore, equal to $\frac{120}{3}$ or 40 years. In other words, all No. 1 strips in the working circle will be clear cut in 40 years and all strips No. 2 and 3 lightly cut. The estimated volume to be removed per acre for each cutting cycle is summarized below:

First Cutting Cycle

| | | |
|---|---|---|
| Clear-cut strip 1 = | 1/3(12,000 bd.ft.) = | 4,000 bd. ft. |
| Light selection strips 2&3 = | 1/4( 8,000 bd.ft.) = | 2,000 bd. ft. |
| T.S.I. strip 1 = | Poles,posts,props | |
| | | 6,000 bd. ft. |

Second Cutting Cycle

| | | |
|---|---|---|
| Clear-cut strip 2 = | 1/3(12,000 bd.ft.) = | 4,000 bd. ft. |
| Light selection strip 3 = | 1/4( 4,000 bd.ft.) = | 1,000 bd. ft. |
| T.S.I. strip 2 = | Poles,posts,props | |
| Thinning strip 1(40yrs.old)= | Posts | |
| | | 5,000 bd.ft. |

Third Cutting Cycle

| | | |
|---|---|---|
| Clear-cut strip 3 = | 1/3(12,000 bd.ft.) = | 4,000 bd. ft. |
| Light selection = | None | |
| Thinning strip 1(80yrs.old)= | Poles,posts,props | |
| Thinning strip 2(40yrs.old)= | Posts,props | |
| T.S.I. strip 3 = | Poles,posts,props | |
| | | 4,000 bd. ft. |

Since the stand is even aged and the submerchantable trees are of no value as growing stock, T.S.I. consists of cutting all the trees below 10.0 inches d.b.h. for whatever produce there is currently a market. Lacking a market, they are felled in order to restock the clear strip as completely and as quickly as possible. In the second cutting cycle, the cut in strip 2 and the light cut in strip 3 assumes that growth in 40 years will bring the volume on these strips back to the original volume at the beginning of the first cutting cycle. From existing, after cutting yield studies, this is a conservative estimate of growth.

The T.S.I. operation in the second cutting cycle is the same as in the first cutting cycle, but coming 40 years later a more ready market may be available for the small material cut. A good market for small material is important at this time because thinning must be done in the 40 year old stand in strip 1. If thinning is not done at this time, a 120 year rotation is too short. Without thinning, at least 200 years must elapse before saw-log material is again available in satisfactory quantities.

In the third cutting cycle, growth in the preceding 40 years is considered sufficient on strip 3 to provide a cut of 4,000 board feet. This is an increase of 3,000 to 4,000 board feet, which should be obtained without difficulty. After the third strip has been clear cut, the light selection cuttings made during the first and second cutting cycles are no longer possible because the working circle is now completely clear cut. Additional medium sized material will be available, however, from strip 1, which is stocked with 80 year old trees. Small material (40 years old) will also be available from strip 2, together with the regular submerchantable trees from the T.S.I. operation in strip 3.

While the board foot volume available for cutting drops progressively with each cutting cycle, the amount of cubic foot volume ready for harvest increases enough simultaneously to offset this loss. New markets must be found for this small material, but that should not be difficult 40 to 80 years hence.

Even though the annual cut is not kept perfectly constant from cutting cycle to cutting cycle, the original forest with a surplus of growing stock is converted by the first cutting cycle in the second rotation to one that is approximately normal. The ease with which lodgepole pine regenerates should result in the complete and immediate restocking of each strip as it is clear cut. The growing stock at the beginning of the first cutting cycle in the second rotation will deviate from ideal only insofar as thinning or intermediate cuttings have or have not been made correctly.

## Broad-aged Stands

The problem in broad aged stands is to bring to maturity the light residual growing stock of submerchantable trees, and, at the same time, convert the old surplus growing stock to a normal growing stock as rapidly as possible. Strip cutting makes possible the development of the light reserve stand because of the protection given to it by the lightly cut strips to the windward. The conversion of the original stand to a 3-age stand with a normal growing stock is not completed, however, until the end of the second cutting cycle in the second rotation. A summary of the volume available during each cutting cycle is given below.

(First Rotation)
First Cutting Cycle

| | | |
|---|---|---|
| Clear-cut strip 1 = | 1/3(12,000 bd.ft.) = | 4,000 bd. ft. |
| Light selection strips 2&3 = | 1/4 (8,000 bd.ft.) = | 2,000 bd. ft. |
| T.S.I. strip 1 = | Poles,props,posts,pulpwood | |
| | | 6,000 bd. ft. |

Second Cutting Cycle

| | | |
|---|---|---|
| Clear-cut strip 2 = | 1/3(12,000 bd.ft.) = | 4,000 bd. ft. |
| Light selection strip 3 = | 1/4 (4,000 bd.ft.) = | 1,000 bd. ft. |
| Second cut strip 1 = | 750 bd. ft. | 750 bd. ft. |
| T.S.I. strip 2 = | Poles,posts,props,pulpwood | |
| Thinning strip 1 = | Posts,props,pulpwood | |
| | | 5,750 bd. ft. |

Third Cutting Cycle

| | | |
|---|---|---|
| Clear-cut strip 3 = | 1/3(12,000 bd.ft.) = | 4,000 bd. ft. |
| Light selection | None | |
| Third cut strip 1 = | 750 bd. ft. | 750 bd. ft. |
| Second cut strip 2 = | 750 bd. ft. | 750 bd. ft. |
| Thinning strip 1(80 yrs.old)= | Poles,posts,props,pulpwood | |
| Thinning strip 2(40 yrs.old)= | Posts,props,pulpwood | |
| T.S.I. strip 3 = | Poles,posts,props,pulpwood | |
| | | 5,500 bd. ft. |

(Second Rotation)
First Cutting Cycle

| | | |
|---|---|---|
| Clear-cut strip 1 = | 4,000 bd. ft. | 4,000 bd. ft. |
| Third cut strip 2 = | 750 bd. ft. | 750 bd. ft. |
| Second cut strip 3 = | 750 bd. ft. | 750 bd. ft. |
| Thinning strip 2 = | Poles,posts,props,pulpwood | |
| Thinning strip 3 = | Poles,posts,props,pulpwood | |
| | | 5,500 bd. ft. |

Second Cutting Cycle

| | | |
|---|---|---|
| Clear-cut strip 2 = | 4,000 bd. ft. | 4,000 bd. ft. |
| Third cut strip 3 = | 750 bd. ft. | 750 bd. ft. |
| Thinning strip 1(40yrs.old)= | Posts,props,pulpwood | |
| Thinning strip 3(80yrs.old)= | Poles,posts,props,pulpwood | |
| | | 4,750 bd. ft. |

Third Cutting Cycle

| | | |
|---|---|---|
| Clear-cut strip 3 = | 4,000 bd. ft. | 4,000 bd. ft. |
| Thinning strip 1(80yrs.old)= | Poles,posts,props,pulpwood | |
| Thinning strip 2(40yrs.old)= | Posts,props,pulpwood | |
| | | 4,000 bd. ft. |

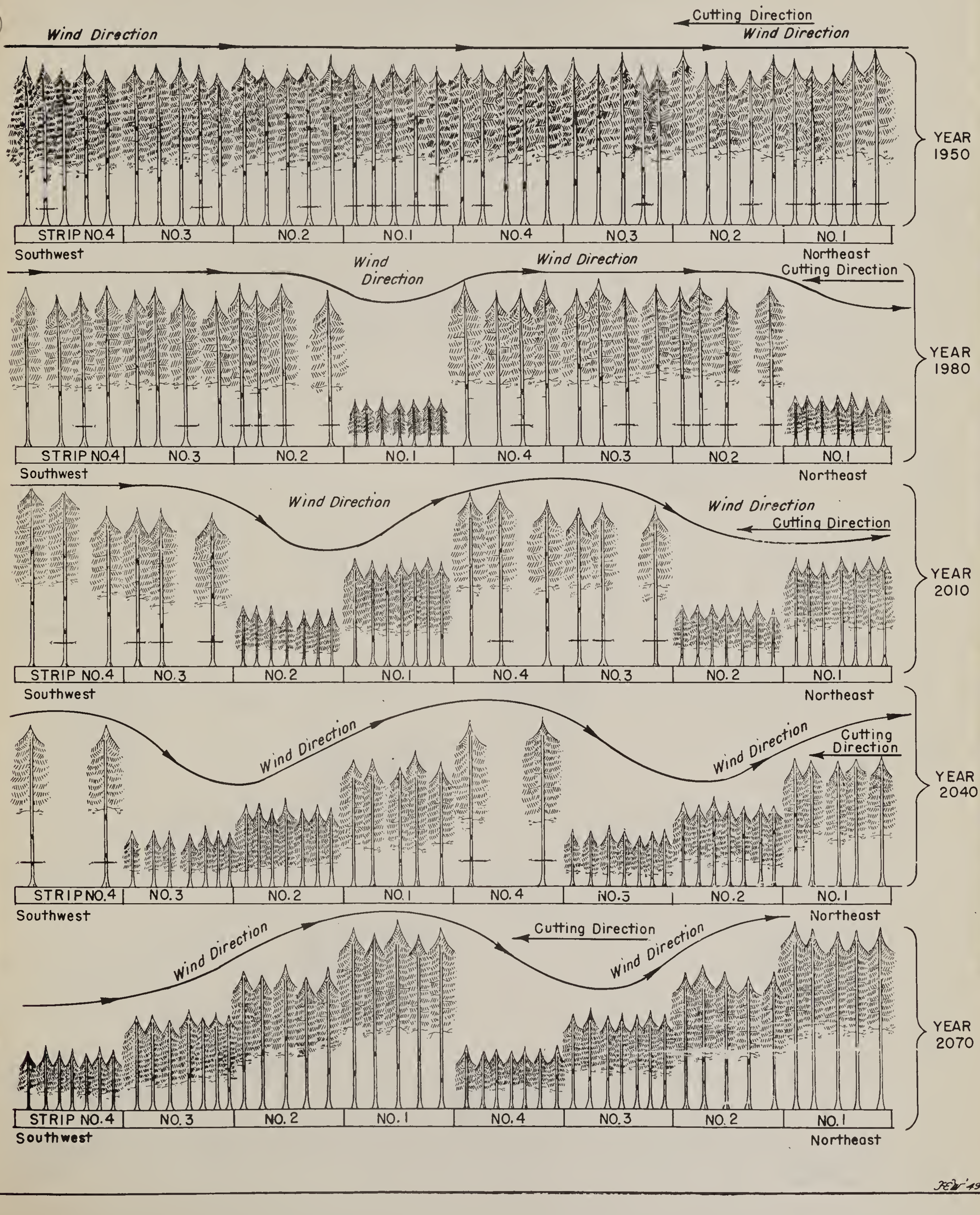
If management can be intensified, the four strip system will permit the reduction of the cutting cycle from 40 years to 30 years (see Figure 2). This is desirable from the standpoint of the intermediate harvest cuttings, which should be made more frequently perhaps than even 30 years for optimum results. More than four strips could be used, but it would make management cumbersome. If more intermediate cuts are necessary than scheduled above, they must be made without the advantage of harvesting a strip of mature, 120 year old trees simultaneously.

Rigidly adhering to the cutting schedule for the three strip system necessitates holding a portion of the original growing stock for 80 years and, for the four strip method, 90 years. Whether this can or cannot be done depends upon the thriftiness of the original stand. If it lacks vigor, it may be necessary to shorten this period to 50 or 60 years. Should this step be taken the growing stock must be brought into balance in the second rotation.

# STRIP CUTTING IN LODGEPOLE PINE

Cutting cycle 30 years - Rototion 120 years

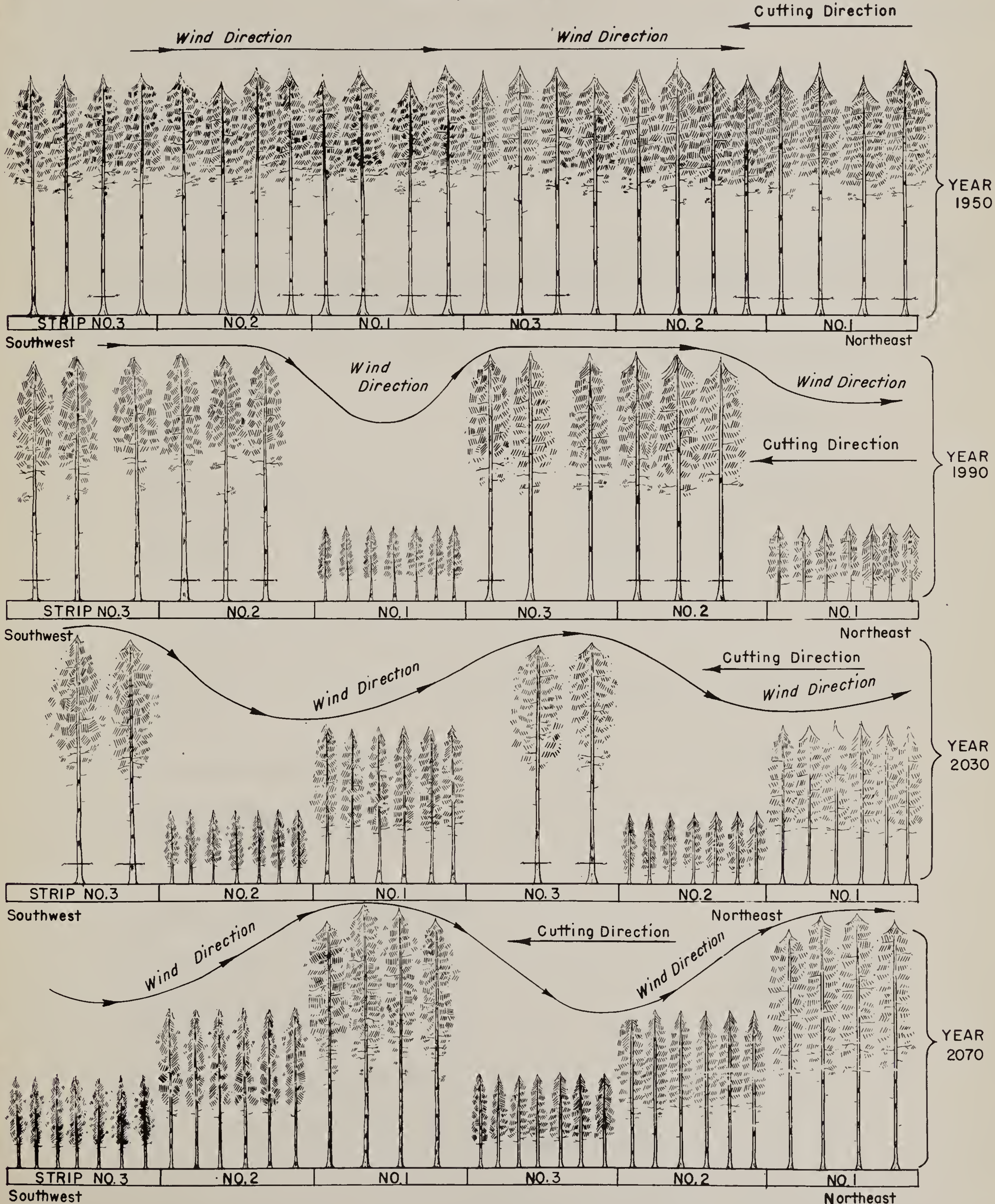
*Compiled by Bert Lexen*



# STRIP CUTTING IN LODGEPOLE PINE

Cutting cycle 40 years – Rotation 120 years

*Compiled by Bert Lexen*




HW '49

# Practical Application of Lexen's Proposal to Lodgepole Pine Stands on the Poudre Working Circle - Roosevelt National Forest - Colorado

by Theodore Krueger - Region 2

Lexen's proposal may appear to some as rather theoretical and not applicable in unregulated stands in our Western Working Circles.

A cutting system is hardly ever applied exactly in practice as given in textbooks or taught in schools. On our western forests, to start with, we generally have a surplus or deficit of one age class and the administrator's job is to take the system and give it practical application to the stand conditions as actually found by survey and gradually convert what you find into an orderly and regulated forest.

The lodgepole pine, as found in the Poudre Working Circle, offers an example of what we have to start with and how we expect to apply the principles of Lexen's proposal a practical way.

Following are the stand conditions as found by the timber survey:

| | | Area Acres | Volume M ft.b.m. |
|---|---|---|---|
| Mature 160+ years | | 54,370 | 287,424 |
| Intermediates | 101-160 years | 21,197 | 41,768 |
| Pole stands | 61-100 years | 45,927 | |
| Saplings | 26-60 years | 17,720 | |
| Seedlings | 1-25 years | 2,203 | |

Rotation 120 years
4 cutting cycles - 30 years each

The following is a suggested application of Lexen's proposal to these conditions:

| | M ft. b.m. |
|---|---|
| **1st Cutting Cycle 1-30 years** | |
| Cut 55% of mature 160+ = | 158,083 |
| + 10% of intermediate 100-160 class | 4,177 |
| | 162,260 |
| **2nd Cutting Cycle 31-60 years** | |
| Cut remainder of 160+ mature = | 129,341 |
| + Remainder of intermediate = | 37,591 |
| + Growth of intermediate | 166,932 |
| + Some salvage in poles | |

**3rd Cutting Cycle 61-90 years**

If no thinning was done, should have at least 5,500 ft. b.m. per acre or 45,927 acres x 5,500 = 248,000 M ft.

However, to balance shortage of area in seedlings & saplings might cut only 33,000 acres @ 5,500 ft. per acre 181,500

4th Cutting Cycle 91-120 years

| | | |
|---|---|---|
| Cut remainder of pole area held over from 3rd cut 12,927 acres | | 66,500 |
| Cut all of sapling area, part of seedling area ready + some light selection in now mature 1st cutting cycle | ) 20,000 acres @ 5,500 ft. | 110,000 |
| | | 176,500 |

If before the end of the 2nd cutting cycle it is possible to make thinnings in the pole and sapling stands, the cut in the 3rd to 4th cutting cycles would be increased.

At end of rotation would have a fairly balanced acreage of the 4 age class stands.

| | | |
|---|---|---|
| 32,000 | acres | mature |
| 43,500 | acres | intermediates |
| 33,000 | | poles |
| 32,800 | | seedlings and saplings |

Increased growth over first rotation will depend on possibilities of markets for thinnings.

The topic outline also asks this question:

> "May two or more methods of management be prescribed for different parts of one working circle?"

This can be answered by "Yes" using the same Poudre Working Circle, as an example, where in addition to the proposed clear cut in strips or small blocks for lodgepole pine as described above, we propose a 40% overall partial cut and 30 year cutting cycle for Engelmann spruce and a 50% tree selection cut with first cutting cycle of 20 years in the mature and overmature ponderosa pine and Douglas-fir stands.

Portland, Oregon
March 24, 1949

# METHODS OF MANAGEMENT AND METHODS OF REGULATION OF CUT IN THE NATIONAL FORESTS OF THE NORTH PACIFIC REGION

By

Philip A. Briegleb
Pacific Northwest Forest & Range Experiment Station

In the North Pacific Region, as elsewhere on the national forests of the nation, emphasis is no longer primarily on protection but on integrated sustained-yield management.

Within the past decade, timber cut on the national forests has accelerated at a rapid pace. During that period the rate of harvest in Region 6 has increased fourfold; in 1948 the regional cut totaled 1,651 million board feet. Estimated harvest allowable under sustained yield is 2,446 million board feet or about 48 percent greater than the present cut. Thus, the timber management work load, already tremendous, will increase still further.

Of the 16,339,000 acres of commercial forest land in Region 6, 9,601,000 acres is classified as old-growth forest. Thus, the principal job of forest management in the region is (1) to direct the transition of wild, predominantly mature and overmature forests to thrifty, managed stands through the processes of timber harvest and related activities. Discussion in this paper is directed largely to this field of effort. Other jobs are (2) to restore or improve the productivity of non- or poorly stocked burns and cutovers, totaling some 696,000 acres, and (3) increase the volume and value of increment in immature stands, covering about 6,042,000 acres, by stand improvement and intermediate harvest cuttings.

## The Douglas-fir Subregion

### Operating Conditions

Timber volume in the mature stands is high. Net recovery per acre averages roughly 40,000 to 60,000 board feet and ranges to more than 100,000 board feet. Tree sizes likewise are large, generally averaging over 36 inches in diameter and they range to over 80 inches in diameter. In logging, the conventional skidding method is by high-lead, using cable and internal combustion engines. Owing to prevailingly steep topography and wet climate it is practical to yard logs by tractors probably on not more than 1/5 or 1/4 of the Douglas-fir region national forest area. Large timber size precludes the use of horses except in second growth. These operating conditions rather sharply limit the application of individual tree selection cutting, particularly in old-growth forests.

The principal market is for logs--sawlogs, pulp logs, veneer logs, shingle logs. Relatively minor volumes are sold as poles, piling, pulpwood bolts, and other primary timber products. Logging and utilization in general are highly mechanized. Average output per man in the woods and in the mill is high in comparison with some other parts of the country. Wage rates are also high, however, and the average output per dollar of costs is probably more nearly on a par with most of the remainder of the country.

### Biological and Other Factors

Douglas-fir, the most important species, is less tolerant than its most common associates. It regenerates in the open or in light shade and after establishment grows best in full sunlight. Hemlock, spruce, the cedars, and the true firs, except noble, are all relatively tolerant. They can grow well in uneven-aged stands, but they appear to attain best development if they start growth in fairly dense, even-aged stands. With the exception of the cedars this group of tolerants is highly susceptible to decay following logging injury. Trees in the natural forest are not particularly wind-resistant, and in some instances are highly susceptible to wind damage. Brush cover of shrub species is variable, ranging from light to extremely dense, but is commonly fairly well established.

The old-growth forest typically is infected with trunk rot and butt rot. In some problem areas not more than half the gross volume of live trees consists of sound wood. Stands of all ages may be infected with root rots that appear to be distributed by small-area foci of infection. In past years quite serious inroads have been made in localized areas by Douglas-fir bark beetles and by the hemlock looper defoliator and currently several outbreaks of spruce budworm infestation have been found in the region.

Annual precipitation is high--generally above 40 inches, ranging to over 100 inches. Most precipitation comes in the fall, winter, and spring. Summers usually are quite dry and frequently bring severe fire weather. This, together with normally heavy slash on cut-over areas, represents an extremely serious and recurring threat to Douglas-fir forests.

The wildlife population of unbroken Douglas-fir forests is low but game animals tend to multiply rapidly in areas of interspersed forest and cutover. Wildlife and recreational uses of the forest are growing as population increases.

Influence of the forest on watershed and streamflow conditions is becoming increasingly important as conflicts develop between the interests of waterpower, manufacturing industries, irrigation, flood control, and recreation. Revegetation of disturbed areas usually progresses at a fairly rapid rate if not heavily and repeatedly burned, but considerable erosion nevertheless results from truck road construction, swing roadways, and from tractor roads.

## Methods of Cutting Used in the Douglas-fir Subregion

Against this background of conditions, current cutting practice has developed. Presently the timber is harvested about as follows:

| | |
|---|---|
| Clear-cut in unit areas of 80 acres or smaller | - 80 percent |
| " " " " " greater than 80 acres | - 10 " |
| Partial cut by tree selection and by small group selection | - 10 " |

Even-aged management is prescribed for the areas from which considerably more than 90 percent of the timber is cut because even-aged regeneration is anticipated on the small group selection cuttings. In addition, some of the tree selection cutting is being made as an intermediate harvest to salvage or forestall mortality with the intent of eventually clear-cutting for final harvest and regeneration.

Slash is usually broadcast burned on clear-cuts to reduce fire hazard and sometimes to reduce shrub cover and improve seedbed conditions. Sometimes slash is left unburned if seedbed and hazard conditions permit. Little or no burning is done on partial cuts. Normally, plans call for cut-over examinations within 5 years after logging and if restocking is unsatisfactory, planting.

Methods of Computing Allowable Cut in Douglas-fir

Anticipating preponderance of even-aged management, the Hanzlik formula is used in computing allowable cut. This formula says:

$$AC = I + \frac{Vm}{r}$$

In which AC = annual cut.

I = mean annual increment of immature stands up to the age when they will be cut.

Vm = volume in mature and overmature stands, i.e., those in which as a group, growth equals loss.

r = rotation selected for management.

Assume, for example, a Douglas-fir working circle averaging site III having at present the age class distribution indicated in the first two columns of table 1. Net recoverable volume per acre in the mature stand is assumed to average 70,000 board feet. A rotation of 100 years is assumed, which approximates estimated age of maximum mean annual increment for saw timber.

Table 1 also illustrates a preliminary computation of increment "I" for use in the formula for a first approximation of cut. Substituting the values in

$$AC = I + \frac{Vm}{r} \quad \text{indicates}$$

$$= 33{,}413 + \frac{2{,}100{,}000}{100}$$

$$= 54{,}413 \text{ M board feet}$$

or, for first approximation, 54 MM board feet.

Table 1.--Preliminary computation of mean annual increment in immature stands

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|
| Present age (yr.) | Area | Years to cut assuming area regulation | | Estimated age at mid-point of cut in each age class | Estimated stocking at harvest | | Total volume of harvest anticipated first rotation | Mean annual increment in immature stands (8) ÷ (5) |
| | | Periodic | Cumulative | | % normal | Vol. per acre | | |
| | M acres | Years | Years | Years | | M bd. ft. | MM bd. ft. | M bd. ft. |
| 160+ | 30 | 30 | 30 | $(160+) + \frac{1}{2}\ 30$ | -- | 70 | 2,100 | -- |
| 100 | 20 | 20 | 50 | $100 + 30 + \frac{1}{2}\ 20 = 140$ | 70 | 60 | 1,200 | 8,571 |
| 40 | 20 | 20 | 70 | $40 + 50 + \frac{1}{2}\ 20 = 100$ | 80 | 50 | 1,000 | 10,000 |
| 10 | 30 | 30 | 100 | $10 + 70 + \frac{1}{2}\ 30 = 95$ | 80 | 47 | 1,410 | 14,842 |
| Total | 100 | | | | | | | 33,413 |

Next step is to use the figure of 54 MM board feet in making an area-volume stand allotment check as illustrated in table 2. This shows that following a cut of 54 MM will result in cutting over the entire circle in 113 years instead of the 100 years contemplated for the rotation. Study of table 2 shows that the average cutting age for each age class will be well above the 100-year rotation if 54 MM per year is harvested. Cutting in the present 10-year class will commence at 108 - ($\frac{1}{2}$ 30) or 93 years, which is well within the usual 15 percent tolerance allowed.

The 54 MM figure can be adjusted on the basis of judgment or by "rule of thumb" calculation similar to the following:

| | | |
|---|---|---|
| Total estimated volume cut in rotation | = | 6,102 MM (113 x 54 MM) |
| Less mature volume | = | 2,100 " |
| Estimated volume of immature | = | 4,002 " |
| Total years to cut all timber | = | 113 |
| 4,002 MM ÷ 113 | = | 35,416 M, av. per yr. |
| For 100-year rotation total immature to cut, estimated | = | 35,416 M x 100 |
| | = | 3,541,600 M |
| Plus mature timber | = | 2,100,000 " |
| Estimated total volume to cut in 100 years | = | 5,641,600 M, or |

Second estimated AC = 56.4 MM board feet

The figure of 56.4 MM can be run through the area-volume computation for checking, after which a recommended figure for AC can be determined readily.

Table 2.--Area-volume stand allotment check of indicated cut

| Current age class (yr.) | Area | Estimated age when cut | Estimated net vol. per acre when cut | Total volume to cut | Years to cut | |
|---|---|---|---|---|---|---|
| | | | | | Periodic | Cumulative |
| | M acres | | M bd. ft. | MM bd. ft. | | |
| 160+ | 30 | Mature | 70 | 2,100 | 39 | 39 |
| 100 | 20 | (100 + 39 + ½ 20) 149 | 62 | 1,240 | 23 | 62 |
| 40 | 20 | (40 + 62 + ½ 20) 112 | 57 | 1,140 | 21 | 83 |
| 10 | 30 | (10 + 83 + ½ 30) 108 | 54 | 1,620 | 30 | 113 |

Application of the Hanzlik formula and related area-volume calculation provide both for reduction of excess growing stock over the first rotation and for avoiding a deficit of growing stock during the first rotation. Adequate growing stock in the second rotation can be insured only if regeneration is obtained promptly and in desirable density and composition.

## The Ponderosa Pine Subregion

The other papers on this topic deal at some length with the pine subregion; thus, the situation in this portion of Region 6 will be but briefly reviewed.

Timber volume per acre is lighter than on the west or "fir" side of the region, the pine types averaging 8,000 to 20,000 board feet. Trees average 30 inches in d.b.h. and range to above 60 inches. In the operating zone terrain is generally gentle in slope, occasionally steep. Tractor skidding is the rule. The timber product market is principally, and in most places almost exclusively, for sawlogs.

Ponderosa pine grows well in pure stands and if in a dominant position it grows well in mixture with Douglas-fir, larch, white fir, and lodgepole. It is much less tolerant than its commonest associates, white fir and Douglas-fir, but when very young has the capacity to survive severe suppression and generally responds well to release except when overmature.

Virgin stands tend to be unevenaged by small even-aged groups. A dense sapling stand is commonly well established in the understory or in small openings. On the moister sites the firs frequently predominate in the understory, even where the main stand is principally pine. Brush-form shrub species, usually not particularly aggressive, become so where encouraged by hard and repeated burns. The western pine beetle has taken very heavy toll in virgin ponderosa stands and one of the primary objectives of management is to reduce losses caused by this insect. The mountain pine beetle, the Douglas-fir beetle, the tussock moth, and the spruce budworm have caused considerable damage to upper-slope forests. Ponderosa pine is comparatively free from defect. It is commonly infected, however--in some places severely--by mistletoe, root fungi, and during moist periods by twig blight, but these infections are less severe generally than are the insect problems.

Growth capacity generally is moderate. The 52 percent of the commercial forest land that is in this subregion includes only 28 percent of the total cut allowable under sustained yield.

Climate is generally moderately dry. Precipitation averages about 25 inches per year, but large deficiencies or excesses of rainfall may persist for periods of up to two decades or so, resulting in pronounced growth and mortality cycles. Only uncommonly does much rain fall during the growing season. Periods of extreme fire weather occur almost every summer, lightning is common, and only the comparatively light stands prevent frequent major fire catastrophies.

Most forests in the pine subregion serve important multiple use functions. They provide forage for both livestock and game and function in the role of watershed protectors in a territory in which water is scarce and valuable. Recreational use is increasing.

Methods of Cutting Used in Pine Subregion

Individual tree selection is followed almost exclusively. A primary objective generally is to reduce losses in the virgin stand and get the forest under control as quickly as possible by cutting as lightly as economic conditions permit. Presently about four-fifths of the timber cut is harvested in selection cuts which remove 40 to 60 percent of virgin stand volume. About one-fifth of the annual cut is harvested in light, sanitation salvage cuts which remove 15 to 30 percent of virgin stand volume. The trend in the initial harvest is toward lighter cutting.

First priority is to mark for cutting those trees of poor current health and high risk. Next component is selected on the basis of longer-time growth and mortality probability as indicated by the Keen tree class. Approach to the cutting of associated species is similar to that used for pine, but scientific basis therefor has not yet been developed. Stumpage values of these other species are usually lower than those for pine and there is less opportunity to do a good job of stand improvement in the cutting process. In the first-cycle cuts now being made, small-area or group selection clear-cuts are rarely applied.

Usual method of slash treatment is to pile and burn in strips along selected roads, leaving the intervening area untreated.

Methods of Computing Allowable Cut

Heyer's formula is used for computing allowable cut for the selection forests of the pine region. This says:

$$AC = I + \frac{\text{(Measured volume) - (Desirable Volume)}}{\text{n years}}$$

In which AC = the volume of annual timber harvest that can be sustained while bringing the forest to its potential level of continuous productivity or maintaining it at that level.

I or annual growth. As used in the above formula this represents the weighted average annual net growth for the tract being regulated over the period of n years. Increment for the first cutting cycle is estimated from growth and mortality probability tables derived from temporary and permanent plot measurements. These are being checked and revised as experience records accumulate from the permanent plots. Potential growth at rotation end is estimated from normal yield tables and will be revised as warranted by experience records.

Measured volume is the net merchantable content of the present forest as determined by timber cruise.

Desirable volume is the volume contained in a managed forest whose growing stock is balanced by having all age classes up to rotation age equally represented. Rotation is usually selected as age of maximum mean annual increment, and desirable volume for balanced growing stock to this age computed as a percentage, usually 60 percent, of normal yield table volumes.

n years - the period during which approximately balanced growing stock is to be attained. In stands preponderately overmature, probably 100 to 200 years, or approximately a full rotation will be required to reach this objective. In exceptional stands having better age-class distribution, "n years" may be no longer than a cutting cycle or two.

This formula provides directly for reduction of excess growing stock or for increase of deficient growing stock.

Preliminary determination of length of cutting cycle is made as follows: (1) Estimate the average volume of cut and percentage of cut per acre that must be made to permit economic operation; (2) assume that the annual cut will approximate 1-1/3 percent of the virgin stand volume present at the start of the cutting cycle. The result for various percents of cut is:

| Average percent of stand volume cut per acre<br>Percent | Length of cutting cycle<br>Years |
|---|---|
| 13.3 | 10 |
| 20 | 15 |
| 25 | 18.7 |
| 26.7 | 20 |
| 33.3 | 25 |
| 40 | 30 |
| 50 | 37.5 |
| 53.4 | 40 |
| 60 | 45 |
| 66.7 | 50 |
| 70 | 52.5 |
| 80 | 60 |

Cutting cycles are not adhered to rigidly. If need for sanitation-salvage cuts arises they are carried out when there is opportunity whether or not they correspond with regularly scheduled harvest cuts.

Some working circles include mixed conifer or upper-slope types, generally evenaged, and for which continuing even-aged management is anticipated. For these, allowable cut is computed by Hanzlik formula as explained for the Douglas-fir subregion and a separate cutting budget is maintained for the different broad forest type or method of management classes.

## How About the Future

In general, the methods of management being used are adapted to the biological conditions and economic limitations that prevail. One job is to improve economic limits through improved forest utilization facilities and market research. In addition, there is infinite detail to be learned about the techniques of applying the methods being used. In other instances we are working into new stand variations for which effective management procedures are not even roughly worked out.

To illustrate some of these points by examples, the staggered setting or patch system of clear-cutting seems well adapted to many of our Douglas-fir situations. But just what is the most efficient size for the unit cuttings; how should they be located and oriented with respect to topography, prevailing winds, and brush situations? Which are the stands in the fir region that will yield greater total timber volume and value if given one or a series of intermediate cuts before regeneration? Another problem we have not yet faced is how to obtain prompt regeneration on the later cuttings of the patch system when the natural source of seed is greatly reduced or eliminated. How long should the delayed settings be left before they are harvested? Where, how, and just when should slash be burned and where had it better be left unburned? These are examples of the very practical questions facing the Douglas-fir forester today, and the adequacy of the answers that are found will determine whether or not we are actually able to sustain, in following cycles and rotations, the future cuts that we are assuming will be forthcoming. We need to learn to recognize in the virgin stand ahead of cutting, brush threat, and other regeneration problem areas so that these can be planted promptly after harvest instead of waiting to see if planting will be necessary and thereby losing through brush encroachment our only reasonable opportunity within a rotation to plant.

In the east-side subregion our silviculture seems to be well adapted to the pure pine type. Trend is in the direction of lighter cutting and shorter cycles. The results are encouraging. We have much to learn, however, about cutting methods best adapted to the mixed pine and the non-pine types which cover more than half the commercial forest acreage of the subregion. We need to know where and how pine should be favored over the other species, where and how to apply small-area group selection clear-cuts, where the ecological trend to more tolerant species can be permitted to continue with some assurance that we will be growing in future years a timber crop somewhere nearly commensurate with productive capacity of the site. Certainly until all of these unknowns are worked out allowable cut should be computed for ponderosa pine and for the other species separately. In general, the need for separate regulation by species, types, or products should be reviewed working circle by working circle in both pine and fir.

We need in timber management to improve our knowledge and our techniques of avoiding excessive erosion on cutting areas and maintaining optimum watershed and streamflow conditions. Many of our cutovers show erosion scars that cannot be tolerated as our use of the forest and its multiple products becomes more intensive.

Most of the management in Region 6 is likely to be even-aged management. In a major part of the fir region, owing largely to topographic conditions, we will be limited to one cut per rotation unless vastly improved logging methods can be devised. However, intermediate cuttings will be possible in the second crop on many areas where this form of operation is impractical with old-growth timber. In some parts of the fir region, particularly the drier, warmer areas, there may be a place for regeneration by the shelterwood method, by small-group selection, and possibly by tree selection, as well as by unit clear-cuts of larger size. A higher proportion of our total yield in the second crop will come in the form of intermediate cuttings than is coming from our virgin stand harvest. In the pine region, regeneration, stand quality, and growth improvement will be of increasing importance when the job of salvaging losses and getting areas under control is further along. There will be places for even-aged, even-aged by small group, and uneven-aged management, frequently on the same working circle. All of this adds up to a future system of cutting methods that must be quite flexible and variable to be adapted to varying conditions.

This development, together with the increasing pressure on the national forests for timber, will require increasingly flexible and refined methods of computing allowable cut.

Our personnel policies as well as our management plans must recognize realistically the trend toward intensive management and set up career positions that will attract and hold the skilled men required to do the job. Some of our most important timber management jobs calling for skill and experience are being done by young, potentially capable foresters in a training capacity. Frequently we are training at the expense of the woods because as soon as a young forester shows real competence he must be shifted to another job in order to promote him. In other countries, having a tradition of centuries of intensive forest management behind them, the procedure is quite different. The top foresters mark the timber to be cut and determine on the ground plans for regeneration and stand improvement, the sequence and directions that operations will take.

The best of plans in the book and specifications in the cutting contracts will bring our forests to their potential productivity and keep them there only if the men who do the job on the ground are highly skilled, enthusiastic, and determined in their zeal to look beyond the expediency of immediate stumpage returns and build an increasingly valuable and productive forest for the future.

S
SUPERVISION
Meetings
(Management Plan Conference)

Topic 20 - Methods of Management and Methods of Regulation of Cut, Region 8

A. J. Streinz

Methods of Management

Most of the national forest land in Region 8 was acquired by purchase, exchange, donation and transfer from other agencies. Prior to acquisition the timber stands on this land was subjected to one or more logging operations for the removal of the merchantable timber. The prevailing stands are therefore young and middle-aged second-growth, and/or culled to cutover old growth and second-growth, and plantations. Silviculturally, the primary need is for intermediate cuttings, i.e., liberation cutting, thinning, improvement cutting, salvage cutting and sanitation cutting.

Management practice, in the past has been, and is currently, chiefly concerned with the systematic coverage of the timber stands by intermediate cuttings. Some of the intermediate cuttings such as improvement cutting, salvage cutting and sanitation cutting when applied to sawtimber stands in poor condition resemble and are in effect reproduction or regeneration cuttings. The terms "light selective cutting" or "selective cutting" have been applied to the system of intermediate cuttings as practiced in Region 8.

The silvical characteristics of the 52 forest types in this Region require the practice of both even-aged management and uneven-aged management in any single working circle and in many single compartments. There are some forest types which may be managed as even-aged stands or uneven-aged stands. This situation will permit the conversion of all stands in such types to one system as seems best locally. There are some types which are probably impermanent and may be eliminated by conversion to adjacent types. On the other hand there are some permanent types which must be managed as even-aged stands or uneven-aged stands. Subdivisions of the working circle with small or ill-defined even-aged stands should probably be managed as uneven-aged stands under the group selection system. Even though the planning and execution of reproduction cuttings are not contemplated during the 5 to 20 years covered by the timber management plan, the applicable silvicultural systems for the respective forest types should be clearly and concisely stated in the timber management plan.

Topography is not adverse to the management of those types which require even-aged management or uneven-aged management. In other types there is sufficient leeway to overcome local adverse topographic situations.

Markets are adverse to the management of stands as even-aged or uneven-aged to a varying degree. In most localities hardwoods and cypress below sawlog size are not merchantable. In a few localities pine below sawlog size is not merchantable. This situation does not permit the removal of such material in commercial thinnings, or the harvesting of unthinned even-aged stands on rotations of 60 to 100 years because of the high proportion of trees below sawlog size in such stands. There is virtually no demand for a few hardwood species and considerable reluctance to take low grade hardwoods in mixed pine and hardwood stands. This situation requires a large amount of non-commercial cultural work in both types of management to maintain or secure a preponderance of the marketable species in the stands.

Other land uses affect the management practice to a varying degree depending upon the local situation. The current policy of prohibiting harvest cuttings in the roadside zones simply means the adoption of the natural rotation as set by wind, insects and disease with cutting limited to the removal of single trees or groups of trees.

Logging operations prior to acquisition of national forest land have to a large extent set the size and location of the stands. In even-aged management the application of clear-cutting in strips or patches with natural reproduction require: (1) that all parts of the clear-cut area be within a specified distance of the uncut portion of the stand; (2) that the uncut portions be not less than a specified width. For example, Shortleaf-Loblolly Pine Type. All portions of clear-cut areas must be within 150 feet of uncut portion and uncut portion must be not less than 50 feet in width. Both the clear-cut and uncut portions comprise the reproduction cutting area. The reproduction cutting area in the clear-cutting method, the seed-tree method, and shelterwood method may be, but should not exceed, the size of the planned reproduction cutting area as determined by the method of regulating the cut. However, the planned reproduction cutting area may be too large if confined to a single locality from the standpoint of utilization, silviculture, and protection. Where there is more than one local market, provision must be made for cutting in several often widely separated subdivisions of the working circle. Silvicultural experience shows small areas are more readily reproduced than large areas. Experience in the protection of the stands from fire, insects, and disease shows large areas of seedlings, saplings, and pole-timber are poor risks. What is small or large must be determined locally. For example in the longleaf type prescribed burning is an intergral part of the reproduction system. Currently it is believed to be uneconomical to burn over less than 100 acres in prescribed burning.

In addition to the items referred to above, the size and location of the stands have another aspect which is frequently overlooked. The planning and execution of reproduction cuttings in even-aged management sooner or later requires the location, and description of each separate even-aged stand. With suitable aerial photographs, the location, area, and most of the descriptive data are readily obtained for even-aged stands of almost any size, but stands of 5 to 10 acres, so located and described, present considerable problems in sampling for volume and increment and in sales preparation. Without suitable aerial photographs, intensive cruises are usually necessary to locate and describe the separate stands. In uneven-aged management the planning and execution of the reproduction cuttings eventually requires a specific description of the growing stock for

definite units of land area such as a compartment or other subdivision. This is usually presented in the form of a stand and stock table based on an inventory for the unit of land area. The intensity and cost of such an inventory depends upon the size of the unit of land area. This suggests that the unit of land area or uneven-aged stand be large to avoid intensive inventories. Perhaps in both even-aged management and uneven-aged management, the size of the stand should approximate that which is required for a well-stocked stand to yield the amount the prevailing unit of logging organization for felling, skidding, and hauling can handle during the logging season.

Rotation as defined by Forestry Terminology is - - "The period of years required to establish and grow timber crops to a specified condition of maturity." The rotation is characteristic of the forest type and silvicultural form of forest. It is not peculiar to even-aged stands alone, it applies to uneven-aged stands as well. It deals with the growing and reproduction of the stands. In each of the silvicultural systems depending upon natural seeding and with reproduction cuttings made during the time of seed fall or immediately thereafter: the shortest possible rotation is the period required for trees to develop the degree of maturity needed to produce ample quantities of seed; the longest possible rotation is the period through which the stand of a given species or mixture may be expected to survive and occupy the soil, i.e., natural rotation.

The "specified condition of maturity" chosen to determine the rotation usually falls between the maturity limits of seed production and natural rotation. In regard to this matter of maturity Section 202.3 Chapter 2 of the Timber Management Section of the National Forest manual states - -

> "In authorizing the use of national forest timber, the law states that 'mature and large grow timber' may be sold. The intent is to authorize the disposal of timber so that it will be of the greatest usefulness to the people of the United States both as to the material removed and as to the effect of its removal on future growth. A tree which should be cut in a thinning in order to improve the condition of the stand is 'mature' irrespective of its age in years. A tree which has attained a size and form which makes it suitable for meeting some definite and useful purpose, such as a telephone pole or piling, may be 'mature' if there is greater need for that product than the prospective need for the wood of the tree in other forms such as the sawlogs which might be obtained if it were left to grow. Some forest areas, even if containing very old trees, would have a greater public usefulness if left intact for scenic, inspirational, watershed protective or other purposes, than would result from the present consumption of their wood, and such areas should not be cut. Maturity will be determined by present and future benefit, and not solely on the basis of years of age or sale value on the stump."

Section 202.3 seems to assign to maturity, and consequently to the rotation, a flexibility which is compatible with uneven-aged management but incompatible with even-aged management. In even-aged management, the rotation is fixed for purposes of regulation. It determines: the number of age classes, the proportion of the total area which each age class should occupy, and the proportion of the total area which should be reproduced annually. Separate even-aged stands are selected for cutting and reproduction to make

up the proportion of the total area to be reproduced annually as follows: (1) stands severely damaged by wind, fire, insects or disease (2) decadent stands, (3) stands of inferior quality or slow growth, (4) stands in the oldest age class division of the adopted rotation.

Chapman (Chapman, H. H. Forest Management 1931. Chapter XXIII) says - - -

> "The cutting cycle is the period elapsing between the initiation of successive logging operations within the same logging unit. This does not mean that cutting must take place within every stand during the cycle. The cycle merely gives the opportunity for such operations wherever there are stands in need of removal. In this logging, only the stands and trees which are mature and designated for cutting will be logged. The remaining trees and stands will form the nucelus of the succeeding cut in the next cycle."

> "The length of the period which must elapse between successive logging operations is determined by the volume of timber demanded to justify the second operation, the number of years required to produce this volume by growth and the density of the stand and diameters of the trees, left after the first logging operation, upon which growth must be laid."

> "It is the problem of the cutting cycle to fix the amount of the annual cut of existing mature timber on the basis which will extend this cut over the first cycle and permit its resumption in the second."

> "In all-aged forests for which it is often difficult to determine the actual rotation required, the cutting cycle serves the purpose of regulation of yield in place of the rotation."

Regulation of Cut

The even-aged stands in most of the working circles in this Region have not been organized for even-aged management. In such a working circle all the stands, even-aged and uneven-aged, are in effect arbitrarily grouped to form a single large uneven-aged stand. Single trees or groups of trees are removed in intermediate cuttings and in addition it may be desirable to make a reproduction cutting or harvest cutting. In the latter, single trees, group of trees or small even-aged stands are removed which have reached a "specified condition of maturity" or are needed to provide the largest possible allowable cut to maintain a community. In practice the intermediate cuttings and harvest cutting are combined. The cutting cycle is the chief means of regulating the cut. The allowable cut in terms of area and volume may be calculated as follows:

Method I

(1) Sample compartments or other subdivisions of working circle which are likely to be cutover in the initial year of the cutting cycle, to determine the total volume, volume cut under the cutting practice, the volume and growth of the residual stand. Estimate the probable volume demanded to justidy a successive logging operation. This may or may not be equal to the volume of the initial cut.

(2) The length of the cutting cycle may be calculated by dividing the estimated volume demanded for a successive logging operation by the annual growth of the residual stand, or

$$CC = \frac{Vc}{Ir} \text{ in which}$$

Vc = volume of cut demanded by successive logging operation.

Ir = periodic annual increment for residual stand left in compartments cutover in initial year of cutting cycle.

CC = years in cutting cycle.

For example -

Compartments sampled

Area - 4000 acres of sawtimber, pole-timber, and sapling and seedling stands with overstory of sawtimber.

All operable if clear cut.

| | | |
|---|---|---|
| Total volume- | 20,000,000 bd.ft. | sawtimber |
| Volume cut - | 7,800,000 bd.ft. | " |
| Volume leave - | 12,200,000 bd.ft. | " |
| Periodic annual increment leave stand - | 976,000 bd.ft. | " |

Volume demanded by

Successive logging operation 6,000,000 bd.ft.

$$CC = \frac{6,000,000}{976,000} = 6.1 \text{ years}$$

It may be desired to build up the growing stock from a leave stand of 12,200,000 bd.ft. or 3050 bd.ft. per acre during the cutting cycle by 1000 bd.ft. per acre or 4,000,000 bd.ft. This amount must be added to the volume demanded by the successive logging operation in calculating the length of the cutting cycle.

$$CC = \frac{6,000,000 + 4,000,000}{976,000} = 10.2 \text{ years}$$

(3) The annual cutting area $= \frac{A}{CC}$ in which

A = acres of operable stands - 100,000 acres

CC = years in cutting cycle - 10 years

$$\text{Annual cutting area} = \frac{100,000}{10} = 10,000 \text{ acres.}$$

(4) Volume check.

(a) If the compartments sampled are reasonably representative of the balance of the compartments to be worked over during the cutting cycle, then the average cut per acre for the sampled compartments may be applied to the annual cutting area to calculate the annual allowable cut,

$$\text{Cut per acre} = \frac{7,800,000}{4,000} = 1950 \text{ bd.ft.}$$

$$\text{Annual allowable cut} = 1950 \text{ bd.ft.} \times 10,000 \text{ acres}$$

$$= 19,500,000 \text{ bd.ft.}$$

(b) If an estimate of the sawtimber volume for the operable stands is available, the annual allowable cut may be calculated as follows:

$(V - Vx)\ (1 + t)^n = V + \frac{V}{a}$ in which

$V$ = present volume of operable stands or 1

$Vx$ = cut or percent cut of present stand.

$(1 + t)^n$ = growth factor for leave stand for cutting cycle.

$\frac{V}{a}$ = amount by which present stand is to be built up during cutting cycle. For compartments sampled:

| | |
|---|---|
| Leave stand | 12,200,000 bd.ft. |
| Amount to be added (976,000 x 10) | 9,760,000 |
| Total 10 years hence | 21,970,000 bd.ft. |
| Present volume | 20,000,000 bd.ft. |
| | 1,960,000 bd.ft. |

$V + \frac{V}{a} = 1.098$ or $1.10$

Simplifying -

$(1 - x)\ (1 + t)^n = 1.10$

$(1 - x) = \frac{1.10}{(1+t)^n}$

$x = 1 - \frac{1.10}{(1 + t)^n}$ = percent cut of present stand.

The numerical value for $(1 + t)^n$ is calculated from data for sampled compartments as follows:

$(1 + t)^n = \frac{Vr + (Ir \times CC)}{Vr}$ in which

$Vr$ = Leave volume - 12,200,000 bd.ft.

$I_r$ = Periodic annual increment leave stand - 976,000 bd.ft.

CC = Years in cutting cycle - 10 years.

Then -

$$\text{percent cut of present stand} = 1 - \frac{1.10}{1.81} = .39 \text{ or } 39\%$$

If the sawtimber volume for the operable stand is 500,000 bd.ft. the allowable cut for the cutting cycle is 39% of 500,000,000 bd.ft. or 195,000,000 bd.ft. The annual allowable cut is 1/10 of 195,000,000 bd.ft. or 19,500,000 bd.ft.

Method II

(1) If, as is often the case, most of the anticipated cut will come from intermediate cuttings, it will be better from the point of view of silviculture to select a cutting cycle of 10 years or less depending on the probable thinning interval for second-growth stands.

Given for operable stands.

Area - 100,000 acres

Volume of sawtimber - 500,000,000 bd.ft.

Periodic annual increment - 40,000,000 bd.ft.

If assumed cutting cycle is 8 years.

(2) Annual cutting area $= \frac{A}{CC}$

$$= \frac{100,000 \text{ acres}}{8}$$

$$= 12,500 \text{ acres.}$$

(3) Volume check -

$$(1 + t)^n = \frac{500,000,000 + (40,000,000 \times 8)}{500,000,000}$$

$$= \frac{820,000,000}{500,000,000}$$

$$= 1.64$$

$$\text{Percent cut} = 1 - \frac{1}{1.64} = 1 - .61 = .39 \text{ or } 39\%$$

The allowable cut for the cutting cycle is 39% of 500,000,000 bd.ft. or 195,000,000 bd.ft. The annual allowable cut is 1/8 of 195,000,000 bd.ft. or 24,375,000 bd.ft. This is the yield from the annual cutting area of 12,400 acres. The average cut per acre is 2031 bd.ft.

If it is desired to build up the growing stock by 1/5 during the cutting cycle, then the percent cut formula should be adjusted as follows:

$$\text{Percent cut} = 1 - \frac{1.2}{1.64} = 1 - .73 = .27 \text{ or } 27\%$$

The allowable cut for the cutting cycle is 27% of 500,000,000 bd.ft. or 135,000,000 bd.ft. The annual allowable cut is 1/8 of 135,000,000 bd.ft. or 16,875,000 bd.ft. This is the yield from the annual cutting area of 12,500 acres. The average cut per acre is 1350 bd.ft.

## Management of Second Growth Shortleaf-Loblolly Pine-Hardwood Stands

Prepared for management portion of Crossett Management Conferences -- October 15-25, 1946

by
R. R. Reynolds, Officer in Charge

The objective of timber management is to grow the maximum amount of high-quality timber per acre per year. In this session we will sum up many of the things discussed during the week and see how all of these can be applied in the actual handling of a forest property. We will go one step further and discuss cutting budgets, marking, records, and overall management.

In order to make this summary realistic it is necessary to make a few assumptions. We will assume that we are in charge of management of 20,000 acres of second-growth shortleaf-loblolly hardwood timber that has not been under management before and that the area is to be managed for maximum production of good quality sawtimber with the production of some poles, piling, and considerable volume of pulpwood from thinnings and improvement cuttings. The principles will apply regardless of what products you wish to grow.

We will assume the area is to be managed on a selection basis, although an even-aged system may work just as well, especially if pulpwood is to be produced.

### Determination of growing stock and growth rate

In any organized effort at timber production it is first necessary to know what we have in the way of growing stock on which to base our plans for management. We also need to have some idea as to how fast our timber is growing. A survey or cruise, therefore, is our first consideration. This cruise need not be an intensive one and the larger the property the smaller percent that is needed. In our case we will make a 5 percent line-plot cruise in order to get a good idea as to where our timber is located as well as obtain information on growth and volume. If we have access to aerial photographs of the area we will, of course, use these to make our base map and possibly our type map. If we cannot get aerial photos we will make a rough map of roads, streams, open areas, and timber types in order to better know the area. In the cruise we will keep our tally separate by 40-acre or similar units. We will bore all pine trees 8 inches or larger in diameter on a 1/100 acre plot (radius 11.8') on each eighth plot for growth information and will measure the diameter growth inside bark over the last 10-year period. At the same time we will record the diameter of the sample trees, the species, and number of logs or volume of the trees.

### Types to recognize

Foresters seem to have a universal failing. They have "typeitus." By this I mean they try their best to recognize as many forest types as possible in their mapping, cruising, and management work. Not only that, but it seems that a type map is no good unless each type is broken down into about a dozen

stand classes. The idea then is to attempt to prepare all the records on the basis of this great number of types and classes. The idea is swell until you start doing it and then you will wake up some morning and find that you will need 69 men and a few others to keep the records and the boss will say you are too costly and will throw the whole works out of the window.

In some cases there is a good reason for mapping lots of types and stand classes. The turpentine region is a good example. It might be very desirable to use lots of types in places when radical differences in soil types occur on a given property. In most cases we have found, however, that under management a large number of our types and stand classes will disappear in a very few years and that after 5-10 years our original classification is no good. My advice, therefore, is to select as few stand types as possible. Recognize the real ones such as upland hardwoods, bottomland hardwoods, and possibly two outstanding pine types but work the rest into one of these. It will save you a lot of work and worry.

Once we have our cruise completed we will work up our volumes by types and will compute the average per acre stand for each type. We will also compute the growth rate for timber.

Growth determination

Perhaps we should discuss this question of growth determination since it is always an interesting and important subject. Many different methods and variation of methods have been worked out for determining the growth of saw-logs, pulpwood, or a combination of products. Most of them aim at building up a growth curve showing for trees of each size and species, the diameter growth of wood, or wood and bark, for a given 5- or 10-year period. There have been many refinements developed to take care of a decreasing growth rate brought on by the closing in of uncut stands. The same procedure is sometimes used to take care of an increasing growth rate that usually follows cutting. All of these methods of growth determination have two weaknesses, however; they are expensive to use, and in stands that are continuously being disturbed by cutting or that are closing in because of lack of cutting, one is quite lucky if he comes within a mile of forecasting the correct amount of growth. Our experience has been that it is much cheaper and the results are better to use growth percent. I am quite sure that you can pull a figure representing growth percent out of thin air and be plenty safe in using it until such time as you can obtain accurate and reliable data from sample plots or check areas. We have found that the growth percent will vary considerably from one 40-acre tract to another, depending upon the amount of growing stock and the type present. Over any reasonable area of second-growth stands, however, the growth percent for pine, at least, will be very similar to the growth percent found on a similar area in the same territory. If the stands are being managed you probably will also find that the growth percent will not vary much from year to year. On the Experimental Forest, for example, the growth percent based on cubic volume of all pine trees 4 inches in diameter and larger has averaged somewhere between 7.2 and 7.6 percent simple interest since we started management. For the same area and same time the growth percent based on board feet, International 1/4" rule, for all trees 11.5 inches in diameter and larger, and including ingrowth during the period, has varied from 8.6 to about 10 percent simple interest for the stands under management.

A timber manager for this territory could use 6 percent compound interest or 7 percent simple interest if he were growing pulpwood and 7 percent compound

interest or 8.5 to 9 percent simple interest if he were growing sawtimber and have a very acceptable basis on which to plan his management and allowable cuts.

To determine if your growth percent is similar to ours it is quite necessary to check it on the ground. This is the reason I have indicated that we would take some increment borings on our first 5 percent cruise.

To check our growth percent from the increment borings we have taken on the cruise we proceed as follows: (1) Set down the diameter, present volume, and the inside bark diameter growth in inches over the last 10 years. From a D.b.h., o.b., and i.b. table for the species in question (sample attached), subtract the present double bark thickness from the present D.b.h. Then subtract the diameter growth i.b. for the last 10 years. Look up the outside bark diameter for 10 years ago and then refer to the volume table to get the volume 10 years ago. The difference between the volumes gives the growth for the last 10 years. The volume growth divided by the volume 10 years ago gives the percent increase, and this divided by the number of years involved gives the percent (simple interest) per year. Likewise, the volume at present divided by the volume 10 years ago gives a figure which, if looked up in a compound interest table, will give the compound interest growth percent.

There are other good methods of computing growth of the sample trees. I like this one because once you have computed the growth of all sample trees you automatically take care of the problem of mortality. If you also only apply volumes to trees that are now at or above the merchantable limit or that, according to our calculations were at or above the merchantable limit 10 years ago, you also take care of the problem of ingrowth.

Actually, we would work up all the present volumes and the volumes for 10 years ago before we computed the growth percent. We must remember that we must have a D.b.h. volume table to compute the growth percents or develop one by curving the tree volumes estimated and computed on the basis of number of logs over D.b.h. We must also remember that we will compute volumes in board feet only for trees over a certain specified size and that in our growth determination the trees that were below this size 10 years ago would have no volumes.

Once we have computed the average growth percent for our stands we can then quickly determine the estimated volume growth for the property we are to manage and can compute our allowable cut. This method of determining the amount of growth the stands or property are producing should be considered only as a stop-gap that permits us to start managing our property at an early date. We must look for better and more reliable data on growth and can only get it through the establishment of some permanent growth study areas. These can be plots of small or large size or can be whole 40-acre tracts. Personally, I prefer the 40-acre tracts if one has sufficient acreage. These would be cruised 100 percent at the time of each measurement. By using 40-acre units the crews can spend all of their time measuring trees instead of half the time running and checking lines and distances and only half of the time measuring trees. Whatever the size, they should be selected by chance instead of having someone pick areas that "appear to be average." The growth plots should be cut in the same manner as the remainder of the property and our records should show the volume by species groups both before and after each cut in order that we might obtain good growth information.

Attached is a stand table for the pine and hardwood found on our pine type. For use in our example we will assume that only one type is present and that

RS-SS
MENSURATION
Volume Tables

Crossett, Arkansas
September 9, 1946

## RELATION OF D.B.H. INSIDE BARK TO D.B.H. OUTSIDE BARK

## LOBLOLLY PINE 1/

| D.B.H. o.b. | D.B.H. i.b. | D.B.H. o.b. | D.B.H. i.b. | D.B.H. o.b. | D.B.H. i.b. | D.B.H. o.b. | D.B.H. i.b. | D.B.H. o.b. | D.B.H. i.b. | D.B.H. o.b. | D.B.H. i.b. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | | | | | | | | | |
| 4.0 | 3.45 | .6 | 6.60 | .2 | 9.75 | .8 | 12.98 | .4 | 16.35 | 22.0 | 19.91 |
| 4.1 | 3.54 | .7 | 6.68 | .3 | 9.84 | .9 | 13.07 | .5 | 16.44 | | |
| .2 | 3.63 | .8 | 6.77 | .4 | 9.92 | 15.0 | 13.16 | .6 | 16.54 | | |
| .3 | 3.72 | .9 | 6.86 | .5 | 10.01 | .1 | 13.25 | .7 | 16.64 | | |
| .4 | 3.81 | 8.0 | 6.94 | .6 | 10.10 | .2 | 13.34 | .8 | 16.73 | | |
| .5 | 3.90 | .1 | 7.03 | .7 | 10.19 | .3 | 13.43 | .9 | 16.83 | | |
| .6 | 3.99 | .2 | 7.12 | .8 | 10.28 | .4 | 13.52 | 19.0 | 16.93 | | |
| .7 | 4.08 | .3 | 7.20 | .9 | 10.37 | .5 | 13.62 | .1 | 17.02 | | |
| .8 | 4.17 | .4 | 7.29 | 12.0 | 10.46 | .6 | 13.71 | .2 | 17.12 | | |
| .9 | 4.26 | .5 | 7.38 | .1 | 10.55 | .7 | 13.80 | .3 | 17.22 | | |
| 5.0 | 4.35 | .6 | 7.47 | .2 | 10.64 | .8 | 13.89 | .4 | 17.32 | | |
| .1 | 4.44 | .7 | 7.56 | .3 | 10.72 | .9 | 13.99 | .5 | 17.42 | | |
| .2 | 4.52 | .8 | 7.64 | .4 | 10.81 | 16.0 | 14.08 | .6 | 17.52 | | |
| .3 | 4.61 | .9 | 7.73 | .5 | 10.90 | .1 | 14.17 | .7 | 17.61 | | |
| .4 | 4.70 | 9.0 | 7.82 | .6 | 10.99 | .2 | 14.27 | .8 | 17.71 | | |
| .5 | 4.78 | .1 | 7.90 | .7 | 11.08 | .3 | 14.36 | .9 | 17.81 | | |
| .6 | 4.87 | .2 | 7.99 | .8 | 11.17 | .4 | 14.45 | 20.0 | 17.91 | | |
| .7 | 4.95 | .3 | 8.08 | .9 | 11.26 | .5 | 14.54 | .1 | 18.01 | | |
| .8 | 5.04 | .4 | 8.16 | 13.0 | 11.35 | .6 | 14.64 | .2 | 18.11 | | |
| .9 | 5.12 | .5 | 8.25 | .1 | 11.44 | .7 | 14.73 | .3 | 18.21 | | |
| 6.0 | 5.21 | .6 | 8.34 | .2 | 11.53 | .8 | 14.82 | .4 | 18.31 | | |
| .1 | 5.30 | .7 | 8.43 | .3 | 11.62 | .9 | 14.92 | .5 | 18.41 | | |
| .2 | 5.38 | .8 | 8.51 | .4 | 11.71 | 17.0 | 15.01 | .6 | 18.51 | | |
| .3 | 5.47 | .9 | 8.60 | .5 | 11.80 | .1 | 15.11 | .7 | 18.61 | | |
| .4 | 5.56 | 10.0 | 8.69 | .6 | 11.89 | .2 | 15.20 | .8 | 18.71 | | |
| .5 | 5.64 | .1 | 8.78 | .7 | 11.98 | .3 | 15.29 | .9 | 18.81 | | |
| .6 | 5.73 | .2 | 8.86 | .8 | 12.07 | .4 | 15.38 | 21.0 | 18.91 | | |
| .7 | 5.82 | .3 | 8.95 | .9 | 12.16 | .5 | 15.48 | .1 | 19.01 | | |
| .8 | 5.90 | .4 | 9.04 | 14.0 | 12.25 | .6 | 15.58 | .2 | 19.11 | | |
| .9 | 5.99 | .5 | 9.13 | .1 | 12.34 | .7 | 15.68 | .3 | 19.21 | | |
| 7.0 | 6.08 | .6 | 9.22 | .2 | 12.43 | .8 | 15.77 | .4 | 19.31 | | |
| .1 | 6.16 | .7 | 9.30 | .3 | 12.52 | .9 | 15.87 | .5 | 19.41 | | |
| .2 | 6.25 | .8 | 9.39 | .4 | 12.61 | 18.0 | 15.96 | .6 | 19.51 | | |
| .3 | 6.34 | .9 | 9.48 | .5 | 12.70 | .1 | 16.06 | .7 | 19.61 | | |
| .4 | 6.42 | 11.0 | 9.57 | .6 | 12.80 | .2 | 16.16 | .8 | 19.71 | | |
| .5 | 6.51 | .1 | 9.66 | .7 | 12.89 | .3 | 16.25 | .9 | 19.81 | | |

1/ Data for second-growth timber.
For use in Crossett, Arkansas, territory.

RE-SS
FINANCIAL ASPECTS
Industrial Forestry
CR-2.1

Crossett, Arkansas
September 9, 1946

STAND AND STOCK DATA

Species Group Pine

Compartment 21

Area Per Acre

| D.b.h. (inches) | No. Trees | Log Vol. | Pulpwood Vol. | P/W below 11.5 inches Vol. in trees |
|---|---|---|---|---|
| | | Bd. ft. | ----- Cu. ft. | ---- |
| 4 | 28.6 | | | 22.9 |
| 5 | 27.0 | | | 45.8 |
| 6 | 21.6 | | | 66.9 |
| 7 | 15.9 | | | 82.6 |
| 8 | 13.6 | | | 106.2 |
| 9 | 12.6 | | | 135.4 |
| 10 | 10.7 | | | 151.2 |
| 11 | 6.5 | | | 117.0 |
| 12 | 6.5 | 647 | 51.6 | |
| 13 | 4.6 | 557 | 37.0 | |
| 14 | 3.3 | 508 | 30.7 | |
| 15 | 2.7 | 523 | 28.4 | |
| 16 | 2.4 | 558 | 24.7 | |
| 17 | 1.7 | 444 | 19.6 | |
| 18 | 1.2 | 382 | 13.8 | |
| 19 | 1.0 | 349 | 14.1 | |
| 20 | .5 | 212 | 6.9 | |
| 21 | .4 | 154 | 5.2 | |
| 22 | .1 | 66 | .7 | |
| Total | 160.9 | 4,400 | 232.7 | 728.0 |
| Equivalent in bd. ft. or std. cords | | 4,400 | 2.7 | 8.6 |

this stand and stock table represents an average acre of our 20,000 acres. As will be noted from the table, the pine sawtimber in trees 11.5 inches in diameter and larger is equivalent to 4,400 board feet, International 1/4" rule, per acre. In addition we have an average of 11.3 standard cords of pine wood in tops of sawtimber trees and in trees below 11.5 inches in diameter. The total volume of the property is, therefore, 88,000,000 bd. ft., International 1/4" rule, of sawtimber and 226,000 standard cords of pulpwood.

Our growth figures indicate that the pine sawlogs in the pine-hardwood type are growing 7 percent per year compound interest, or about 9 percent simple interest. This percentage includes ingrowth, or the volume contained in trees that become of merchantable size during the year, as well as the growth on the merchantable sizes. The total growth on the property would, therefore, average about 6,160,000 bd. ft. of logs per year if cutting was equal to the growth. In addition, the growth on the pulpwood sizes and grades would be equivalent to about 15,820 cords. Under certain circumstances we could cut all of the board foot growth each year and still be on sustained yield. In our case, as well as in most cases, our stands are quite badly understocked and are producing only about half the amount that the land is capable of producing. We are growing somewhere around 300 bd. ft. per acre whereas the land is fully capable of growing 500 to 600 bd. ft., or one to two cords of pulpwood per acre per year if and when we develop sufficient growing stock. Under our plan of management we wish to grow as much as possible. We, therefore, must of necessity cut less than the growth at the present time in order to be sure that we can obtain a greater cut per acre at some near future date.

Our figures indicate that the yearly growth of pulpwood in tops of sawlog trees and in trees below sawlog size is equivalent to 15,820 standard cords. Here, too, we cannot or should not plan on cutting this amount of material each year. Part of this growth is lost because it is in trees that grow into sawtimber size during the year and in subsequent years, and in order to allow for an increase in the sawtimber growing stock in the future we must allow for a large percentage of these trees to become of sawlog size. The first time we cut through our stands is an exception to the general statement that the cut of pulpwood size and quality material should not be equal to the growth. The unmanaged stands contain numerous dense groups that need to be thinned, some trees are very rough and some have heart rot or other defect and need to be removed.

Rotation

In school the term "rotation" was probably drummed into you from morning until night. Nearly all forest practice apparently hinged upon the rotation under which the timber was being grown. Southern pine was to be handled under a 100-year rotation, Douglas fir required a 200-year rotation, etc. Even today a good many foresters who are managing their land on an all-aged basis have a feeling that unless they know what rotation they are using their management isn't worth too much. Actually, we do not have much of any idea as to what rotation we are or should be using in southern pine. We are not far enough along in our intensive management to know.

I agree that there is a good reason for those attempting to manage their properties on an even-aged basis to have some idea as to what rotation they will use. For those of us managing our timberlands on an all-aged basis, we don't care what the rotation might happen to be. As a result of the manner in which the trees are selected for cutting, some of the mature individuals may be 125 years old when they are cut and some may be 50 years old. It

really makes little difference since our management can be handled very nicely on a short cutting cycle basis and by so doing we can have very excellent day-to-day control of our management policies and practices.

Cutting cycle

Our experience to date has indicated that the shorter the cutting cycle that we can use the greater will be the growth. Short cycles mean lighter cuts per acre but at the same time they permit better treatment of the stands. There is less chance of having periods of fast growth followed by periods of slow growth as the stands close in near the end of a long cycle. On the other hand, the cut per acre at any one period must be sufficient to make possible reasonable logging costs. It is necessary to log approximately 1,000 bd. ft. per acre under present conditions to interest a contractor in the cutting of the timber. This means that we will be required to adopt an 8-year cycle in our example. At the same time we should plan very definitely on using a 5-year or shorter cycle as soon as our stands are built up enough to permit it. Once our stands are built up to near full stocking of 10,000 bd. ft. of sawlog material we should probably adopt a 3-year cycle.

Division of property into compartments

In starting management of a property it undoubtedly is good practice to pick out the areas that are in greatest need of treatment and cut these first. It is also undoubtedly good business to put the whole property in good growing condition as rapidly as possible. Once this is done, however, good management of an area requires that we not jump all over the property to select our areas for cutting in any one year. If we are to hold to our cutting cycle once we make a cut on a given 40 acres, we automatically set the date when we must or should return to this area for a second cut. Therefore, in our cutting operations we should, after the improvement cut is completed, adopt a definite plan of area control. Since we have accepted an 8-year cutting cycle we should divide the 20,000 acres into 8 compartments or blocks of 2,500 acres each and plan to cut one area each year. These compartments should, insofar as possible, contain roughly an equal volume of growing stock in order to obtain about the same amount of production each year. The order, or year in which any given compartment will be cut, should be determined on the basis of maturity or density of the timber.

Determination of allowable cut for property

Before we decide how much volume we can cut per year on our property, or more specifically, on the 2,500 acres to be cut during the year, we should build up a table or curve which will show, for any given volume, how much we can cut and still allow for building up of the stands. This can be done in the same manner that table 51 of Technical Bulletin No. 861 was built up. This was developed from table 50 which in turn was built up from a detailed study of growth, growing stock, and cutting ratios. Once the growth percent and the cutting cycle has been determined table 50 will give the maximum allowable cut that will permit sustained yield. In our case the maximum allowable cut for a 7 percent growth rate and an 8-year cutting cycle is 42 percent of the sawlog growing stock. This means that each time we cut over a given area, or an 8-year cycle, we could cut selectively 42 percent of the stock and have this volume restored by the time we returned for a second cut. Such a cut, however, would not allow for any increase in growing stock and, therefore, would only be made in case of a fully stocked stand of 10,000 board feet of sawlogs or 24 cords of pulpwood. For stands containing only 2,000

board feet of sawlogs per acre we would cut only about half of the growth and allow the other half to be added to the growing stock. This means that instead of cutting 42 percent of the stand we would remove 21 percent and allow the other 21 percent to be added to the growing stock. For stands containing a volume somewhere between 2,000 and 10,000 board feet the percent of the growing stock cut would increase with each increase in volume of growing stock, In other words, if the volume per acre was 6,000 feet, we would cut a volume equivalent to about 32 percent of the growing stock. We would cut more of the growth and add a smaller percentage to growing stock than on stands having 2,000 board feet per acre. At the same time we would still add about one-fourth of the growth to growing stock. The completed table of suggested percents of growing stock to cut, with a 7 percent growth rate and an 8-year cycle, under various volumes per acre are as follows:

Suggested proportion of volume of sawtimber growing stock to be cut in each 8-year cycle for stands that are growing 7 percent compound interest

| Growing Stock | Vol. of growing stock to cut each cycle | Growing Stock | Vol. of growing stock to cut each cycle |
|---|---|---|---|
| 10 M | 42 | 5 M | 30 |
| 9 M | 39 | 4 M | 26 |
| 8 M | 37 | 3 M | 24 |
| 7 M | 35 | 2 M | 21 |
| 6 M | 32 | | |

Since our stand averages 4,400 board feet per acre, we can cut about 27 percent of the growing stock each cycle. Thus, we can cut an average of about 1,188 board feet of pine sawlogs per acre during the first cycle and the total cut of sawlogs per year would equal about 3 million feet of pine plus whatever hardwoods of sawlog size that need be removed to benefit the stand.

If the stands on the theoretical 20,000 acres are similar to the stands on the Experimental Forest the amount of pulpwood removed from tops and from improvement cuttings in the under sawlog-size classes would be equal to about 2 cords per acre for the first time over the property. This would give us about 5,000 cords of pulpwood per year. In second and third selection cuts of the same areas the cut per acre would run from 1.0 to 1.5 cords of pulpwood per thousand feet of logs.

Determination of allowable cut for stands

In each 2,500-acre compartment that we are to cut over each year we obviously have some areas that are inoperable because they contain no merchantable or few merchantable trees. Other areas have 3,000 feet per acre, others 6, 8, 10, and a few perhaps 15.000 or more board feet per acre. We obviously do not wish to cut the same 1,188 board feet per acre regardless of the growing stock. To solve this problem we make use of our 5 percent cruise and determine the allowable cut for each 40 acres or on each 80 to 160 if the stands are uniform. In this way we can treat each small tract in accordance with its needs and can get our production from those areas that are producing most. We realize that the 5 percent cruise will not give us a wholly accurate basis on which to determine an absolutely accurate allowable cut but with some slight adjustment in the marking to take care of abnormal conditions it will be plenty accurate for our purpose.

Determination of flexible diameter limit for marking

Any marking or cutting that is based on a fixed diameter limit is usually not satisfactory from a management standpoint because it leaves poor trees in some cases and causes excellent fast-growing ones to be removed in others. We have found that the use of a flexible diameter limit is a good means of getting around this difficulty. The determination of a flexible diameter limit also aids considerably in the selective marking of the stands that are being cut for the second or third time because it does tell the marker the relative size of trees that will be removed. To determine this flexible diameter limit let us refer to the average pine stand table for our 20,000-acre tract. Let us assume that this is a stand table for one of our 40-acre tracts that we are to mark tomorrow. If all trees were equally good and well spaced, about what size should we remove? Perhaps we should not remove any if we were thinking strictly from the standpoint of maximum growth. But people have to work, the mills have to be kept going, taxes must be paid and we must have something to live on, so we must cut some regardless. We determined before that our allowable cut for a stand of this volume is equivalent to 1,188 board feet per acre. We, therefore, start adding sawtimber volumes by diameter classes, starting with the largest trees, or 23-inch class in our case. To this volume we add the volume for the 22-inch class, the 21-inch class, etc., until we have 1,188 board feet. In our case this brings us to the 18-inch diameter class. We now know that if we were to mark all trees in and above this diameter class we will have marked all the volume we determined we would mark under our computations on allowable cut. In actual practice, however, this computation only furnished us with a guide. We mark trees of any merchantable diameter over 11.5 inches that need to come out because of necessity of thinning or because of roughness or defect. To balance this volume cut in trees below the flexible diameter limit we leave an equal volume in good, well-spaced, rapid-growing trees over the diameter limit. By keeping in mind the volume left in trees over the diameter limit and the volume of trees marked for cutting in diameters below the limit, one can mark almost exactly the volume desired on a given area without keeping any kind of written record.

Type of trees to cut

The first time we mark an area for selective cutting is by far the easiest of all marking that we will do because the trees that obviously need to come out of the stand are quite apparent. The trees that we will remove include:

1. Mature or over-mature.
2. Badly scarred or leaning.
3. Red heart (or other rot) and bug-damaged trees.
4. Very limby trees with less than one #2 log if of log size, or those dominants with large limbs clear to the ground if of pulpwood size.
5. Badly suppressed trees that will not live over the next cycle unless released.
6. Trees regardless of quality that must be removed to permit better trees in the group in which they occur to grow at a satisfactory rate over the next cycle.
7. Trees of low value species that are occupying land that can or will be utilized by trees of a better species.
8. Sufficient large near-mature trees to make up the remainder of our allowable cut.

In the second selective cut in the same stands we, of course, remove any of the above-mentioned low-quality trees that we can find but there is usually

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

few of these to be found. We will have some rot show up and we will find more trees that have become suppressed during the period. For the most part, however, we will mark for spacing and quality. Unless a group of immature trees have good crowns and growth rate it is quite necessary that we remove some of them. At the same time we do not wish to remove a good quality suppressed tree if that tree will live over the next cycle and it will be released at the time of our next cut through the removal of the overtopping tree.

## Treatment of hardwoods in the stands

As yet nothing has been said about hardwoods. On a good hardwood site they are excellent. Some few individuals of some species are good growing stock in some pine types and sites. I do not mean to suggest that we sell hardwoods short, but most hardwoods in the pine sites are distinctly not desirable growing stock. Moreover, these hardwoods are definitely interfering with the development of the present growing stock as well as keeping new growing stock from developing. It has been estimated that these low-grade hardwoods are occupying nearly half of the effective pine-growing space and are, or have, or will reduce the potential pine growth per acre per year by nearly half. Under the circumstances, no stone should be left unturned to reduce these hardwoods at the earliest possible date. Consequently, no allowable cut is figured for hardwoods except on hardwood sites. It seems to be good business to grow some red and white oak and possibly some gum on our pine sites, but satisfactory trees of these species that can compete with pine from a growth per acre standpoint are relatively few and far between.

## Reinventories

In order to have a basis for necessary management plan revisions, to get a check on the growth that has taken place on the whole property, and in order to have data on which to base the allowable cuts for the second cycle of management, it is quite necessary to make a new 5 percent cruise of the whole property at the end of the first cycle or at the end of 8 years. This can be done all at once, or the job can be split up and the 2,500 acres that are to be cut during a given year can be cruised just before marking and cutting is started, thus having up-to-date figures on which to base the cuts during the year.

## Records

Any good and efficient business must of necessity maintain a good set of records. The timber-growing business is no exception. In order to know what we have, what we have accomplished, and where we are going, we need a good set of forest records. These need not be extremely costly or all-inclusive, but they should tell us what volume of timber, of what sizes and species, we have when we start. They should also tell what we have removed during a given period and what we have at the end of the period. Detailed records, such as I am suggesting, should only be kept for our "check" or growth study areas, but we should have enough of these to get a good accurate picture of our operations. The records should include: (1) Volume data on original stand by species groups and year, (2) volume marked for cutting by species groups and year, (3) volume present at time of reinventory and year. Another column that could be added would be, "Growth plus cut for period between inventories."

I would set up such a record for each 40 or other unit that is used as a check area so as to get good information on growth under various volumes and species composition.

S
SUPERVISION
Meetings
Management Plan Conference

TOPIC 20

# METHODS OF MANAGEMENT AND METHODS OF REGULATION OF CUT, EASTERN WORKING CIRCLES - REGION 7

Practically all of the land included in Region 7 came into Government ownership through the purchase procedure. For the most part it includes culled-over, cutover and badly wrecked stands that have been exploited by private operators over a long period of years. Prior to acquisition by the United States, much of the land was subject to severe recurrent fires which not only depleted the soil fertility but also damaged many of the trees comprising the present stands. The volumes of sawtimber remaining from heavy exploitation in private ownership are scattered and generally of poor quality. Nevertheless, the recuperative powers of the soil are strong and on the better sites, the young forest is growing up rapidly.

As heavy exploitation of privately owned nearby stumpage progresses, the local dependency on National Forest stumpage is continually increasing. Private cutting of immature stands is widespread and destructive. To contribute its share toward sustaining local industry, the sawtimber elements of the National Forests have been budgeted for cutting at a level designed to furnish a continuing supply while the young stands are growing into usable size. Other products, principally in the form of hardwood cordwood, are available and increasing in volume far more rapidly than we have been able to dispose of them to existing outlets. Large areas of young timber are in need of thinnings and improvement cuttings for which additional outlets must be developed. This is the only way in which the loss through mortality can be captured and the growing stock put into the most productive condition. Herein lies the Region's biggest management problem. To it is tied full production, the best silviculture and the largest contribution to local economy.

The early history of management on Region 7 Forests records silvicultural systems leaned heavily to clear-cutting methods and a trend toward even-aged management. In the 1920's and early 30's, the forests were relatively undeveloped, transportation systems were embryonic and much of the timber left from the exploitive years prior to Federal acquisition was hard to get at. Fairly heavy cuts per acre were necessary to interest a logger. Except on the most accessible sites light cuts and true selection systems of silviculture were mostly impractical. Consequently, we found a relatively high proportion of the areas treated with various forms of clear cutting. Early plans of management specified such methods, and even-aged management seemed to be the result of circumstances. Many foresters argued that the best second growth hardwood stands known were the results of clear cutting for charcoal and that such methods should be perpetuated. It was a $64 question. Subsequent examination of many of the earlier sales where clear cutting was used does not always bear out the earlier philosophy. New stands are largely of sprout origin. Often less desirable species such as soft maple, black gum, grey birch or moosewood took over the site, and all was not as it should be. We saw little difference in the appearance of cutover areas on the National Forest and those on private

land nearby. We weren't too sure of ourselves, and we took another look at what we were doing and ought to be doing. Meanwhile, the remote country was being opened up with the CCC and other programs, and the possibilities of more intensive forestry were improving.

The majority of the commercial forest land in Region 7 Forests carried hardwood timber in types that originally comprised varying mixtures of numerous hardwood species. Exceptions to this, of course, are the spruce-fir types of New England and the original hemlock-white pine types of the Allegheny plateau. Within these latter classifications are native softwood soils which because of exploitation, fire or other causes now carry hardwoods. Observation through the past 30 years under adequate protection and what management we were able to apply, indicates a gradual return toward the climax or natural balance. For example, the filtering of spruce and fir into presently hardwood mixtures in the north woods, hemlock on the Allegheny and white pine in Virginia is very noticeable. The tolerance of these species, at least in the early stages, makes this possible.

Since the bulk of our area was and is hardwoods with varying admixtures of softwoods, it is important that management work with nature rather than against her in assisting the return to normality. In a hardwood country the cultivation of useful softwoods to a practical degree is a significant long-range objective. The hardwood types either with mixtures of softwoods or all hardwoods are rather complicated, with species of varying tolerance and utility. By the same token the silvicultural and management practices become complex. We are convinced now that with uneven-aged management we can attain the highest production from the land with an increased growing stock, and at the same time progress toward species composition that is in best balance with the soil type. Furthermore, the demands of aesthetics, the reduction of erosion and turbidity on important watersheds and to some extent the needs of wildlife add weight to a choice of uneven-aged management.

This conclusion is not for 100% application. Generally speaking, all aged forests are chiefly comprised of tolerant species and uneven-aged management implies light and frequent cuttings on a tree selection basis, and considerable acreage must be operated to yield appreciable volumes. At the same time some of our most valuable species like yellow poplar, black cherry or white ash are highly intolerant. To retain a satisfactory representation it is often necessary to compromise true selection methods with heavy cutting in groups, strips or patches to assure satisfactory regeneration and development of the intolerants.

Again, uneven-aged management is not feasible in sections where only an extensive form of forestry is justified. For example, from a silvicultural standpoint, spruce-fir forests should be under a form of uneven-aged management. Yet we may have lightly stocked stands, or high slope areas where because of excessive logging costs, high per acre yields are necessary for practical operation. So within a given working circle we may find it necessary to have both even and uneven-aged management, and for any successful plan the areas upon which each is to be applied should be well established.

A lot of our country is in view of large numbers of the traveling public. The importance of this factor is increasing. It reaches its peak expression in the highly scenic drives, parkways and trails which thread much of our area, and from which considerable areas beyond the road or trailside itself have

important aesthetic value. Totally aside from silvicultural or management consideration, limitation of clear cutting may be necessary and plans should specify locations and size. Some sacrifices of silvicultural ideals may be necessary to meet the overall demands of well balanced multiple use. Disturbance of the soil may limit the size of clear cuttings allowed in any one period on municipal or industrial watersheds.

Notwithstanding the limitations outlined above, the species of trees which make up a forest and their silvical characteristics should be fundamental considerations in the choice of management methods. Management methods should be silviculturally correct to assure prompt attainment of silvicultural goals. To the extent that we are forced to compromise silviculture, to that extent will we fall short of attaining these goals.

In uneven-aged management rotation age is not too significant. Should it be determined that because of market demands or soil condition it is in the best public interest to produce shortwood rather than sawtimber, some determination of rotation age or size for the shortwood crop as compared with the sawtimber harvest is necessary. Otherwise, in a true selection stand maturity is more a matter of tree condition and utility than of age.

The volume method of regulation has been used in Region 7. Considerable growth and stand table data were obtained as part of the CCC program. These data have been extensively used in the preparation of our management plans. It developed, however, that much of the basic data were not of too reliable a nature. As a result of this condition the usefulness of a number of our present management plans has been seriously impaired.

As indicated earlier, uneven-aged management appears best suited to the forests of this Region. The structure of such forests makes regulation of cut by the area method alone difficult. Yet it is important that the allowable cut be allocated to areas silviculturally in most need of cutting. This objective can best be attained by regulating the cut by a combination of volume and area, using area primarily to control the allocation of the cut.

Many of the working circles have surpluses in materials of relatively poor promise, principally in the form of cordwood, which should be removed in thinnings or improvement cuttings to get the stands on considerable areas into best condition as to density, composition and thrift. One of the major management problems on our National Forests, therefore, involves disposing of large quantities of these low value materials and building up the quality and quantity of growing stock. The problem is silvicultural but fully successful silviculture is dependent upon expanded markets. Management plans should, therefore, be directed toward the solution of both aspects of this problem as rapidly as possible. This can be best achieved by adhering to a cutting plan whereby the cut during any given period is less than the increment for that period. It follows, therefore, that the rate at which desirable growing stock is built up will depend upon the proportion of the increment retained. To provide a basis for controlling the rate of such accomplishment, accurate data are needed on the rate at which the stands are growing. This can best be provided through the establishment of permanent growth plots so distributed as to obtain a representative sample of the working circle. Systematic accumulation of such data would make it possible to continually improve the effectiveness of our management plans.

On the basis of our experience we do not foresee any immediate need for Formula methods. Use of Formulas to-date has been limited to checks against cutting budgets arrived at by methods now employed.

Each working circle presents problems of regulating both the annual cut and growing stock. In determining the allowable cut, stands, species and products must be considered. Under Region 7 condition, live sawtimber species and stands occurring on commercial forest areas that are subject to economic operation are regulated. Spruce and fir pulpwood on the New England forests is also regulated. Dead timber, such as chestnut which occurs in the southern part of the Region, is not regulated. In general, products such as hardwood pulpwood, mine timbers and posts are not regulated. The only important exception in this respect is the regulation of hardwood cordwood on the Allegheny National Forest. This plan is based on a recent inventory which contains what we believe to be reasonably reliable figures on hardwood cordwood volumes. In some of the older plans an attempt was made to regulate cordwood and locust posts. In many instances the basic data used were incomplete with the result that the regulated volumes as set forth in the plans are known to be wide of the mark. All of our working circles contain a large amount of products which should be removed in the form of thinnings and improvement cuttings to the limit that the markets will absorb them. While careful attention is being given to developing additional outlets for products, progress is slow. Until the demand increases to the point where it is really significant from the standpoint of supply, the regulation of miscellaneous hardwood products is meaningless.

D. W. Tabbutt

March 15, 1949

March 8, 1949

# A METHOD OF REGULATING CUT IN INDIVIDUAL STANDS

By Paul Zehngraff 1/

Most forest management plans and schemes for regulating the cut deal with large tracts. The data and recommendations for regulation set forth in the over-all plan may apply perfectly to the tract as a whole and to the top men, but very seldom will they apply to the individual stands or be especially useful for the field men who must apply the plans to various stand conditions. The purpose of this paper is to stress the importance of the field man's job and to try to help him in his task.

In the Lake States region we deal primarily with second-growth and young timber. Our problems, therefore, differ considerably from the regions that still carry large quantities of virgin timber. Although our timber is small and often of inferior quality and species, we have the advantage that it is situated right in the "back yard" of the wood-using industries and that the production of these concerns is geared to local conditions. As a result, we get good enough prices for the material we are able to produce, so that fairly intensive forest management is, or can be, a paying proposition. As a matter of fact, intensive management, up to a certain point, is the only kind of management that does pay in our region. As a result, the forest management concepts in the Lake States are rapidly changing from the harvest-philosophy of the pioneer days into concepts of making the best of what there is to work with.

What, then, are some of the aims of management?

One of the chief difficulties is the present run-down condition of the bulk of our stands. They are practically all natural or wild second-growth stands, which include some culled-over remnants of the original forest. As such they are most frequently understocked and produce neither the quantity nor the quality that we desire or of which they are capable. The most important present objective, therefore, is to build up the growing stock as a whole. This will gradually result in higher production.

But, we are not interested in quantity alone. We know that our soils and climate can not produce the annual growth per acre that is possible in some more favored regions. We must, then, be primarily concerned with quality. In other words, we must strive through careful management to develop as much of our growing stock as possible into the highest possible local uses. By that we don't necessarily mean that we want to grow trees as large as the old virgin stands which were 200 to 300 years old. To grow extra large trees for saw-timber production usually does not pay because of the very slow growth that takes place after the trees reach certain diameters.

1/ Silviculturist, Lake States Forest Experiment Station maintained by the U.S. Department of Agriculture, Forest Service, in cooperation with the University of Minnesota, at University Farm, St. Paul 1, Minnesota.

We can, however, grow pines up to 20 inches d.b.h., but from then on the growth is usually so slow that the time it takes to grow the larger trees soon eats up the profit. In several cases, however, the highest value of our products, such as in poles and piling, is reached in diameters less than 20 inches.

To attain better stocking of the most suitable species, and to manager these for their highest financial local uses are, then, the chief aims of management.

Bearing this constantly in mind in our management practice, one of the most effective ways of improving the stocking is to cut as much less of the growth during a given period as is deemed necessary to build up the stand to the required growing-stock levels or carrying capacity of the soil. In other words, it is not what we take out of a stand in each cut that determines the financial feasibility of management in the long run, but it is what we leave for growing stock, both in volume and kind.

In making management plans for large tracts, the growth and allowable cut is determined for the whole tract, or by ranger districts or working circles. This is at best a rough picture. It may tell the forest manager approximately what his annual growth and cut ought to be, but even if this is broken down by types it still does not help him appreciably in determining the management of individual stands. The individual stands may vary considerably from the average for the type or working circle. Unless the best management is applied to each stand and condition the broad management plan will fail in its purpose.

To accomplish the purposes of the management plan and the concepts of management, the field men need help and training. They must be taught (a) to recognize what constitutes optimum growing stock levels of the species and age classes they work with both in regard to the kind and amount; (b) to determine the rate of growth in each particular stand; and (c) to decide how much of this growth can be removed in each cut in order to attain the desired growing stock level in a given time if the stand is understocked or, in less frequent cases, how much to reduce it if the stand is overstocked.

To determine what constitutes optimum growing stock to produce maximum growth in the different species and age classes is a high priority job for the Experiment Stations, but in most cases the work is far enough along so that guides can be issued--at least for some types.

This leads into another thought, namely, how to measure growing stock. In quite young stands the number of stems are used as a measure; when they reach pole sizes we use cords; and still later in life we express the stocking in terms of board feet. Each unit has its merit, but as an expression of growing stock they are all misleading due to various factors such as, for instance, the ingrowth that takes place up to certain ages. Cubic measure would be more expressive, but most field men are unfamiliar with its use and would be reluctant to change over. One measure they are all familiar with, however, is basal area. Basal area is a good indicator of carrying capacity of the soil because it may be expressed as a certain percentage of the soil area. Basal area, like cubic volume, should, under normal conditions, gradually increase up to a certain point prior to the halfway mark of the rotation of any species. When this point has been reached, the basal area remains practically constant until shortly before the end of the rotation. Basal area is simple to use in the field, for only the number of trees by d.b.h. classes needs to be recorded on the inventory plots, and the growth is equally simple to compute, even in the field.

When it comes to determining the growth and the allowable cut, various formulas may be used. For direct use in the field the simplest methods are the best. The more complicated the methods the less apt they are to be used. It is essential, however, that some system be applied by the field men to the individual stand, for if growth and allowable cut is not determined and the stand cut accordingly, the cutting might, and often does, result in loss of growth. How anyone can go out in a stand and start swinging the marking axe without first having a picture of past performance and future possibilities of the stand, and some sort of a plan for its future management, is simply beyond one's imagination--and yet, one sees it done every day.

One of the simplest methods of determining growth, one that has been started on the Chippewa Forest, is to use permanent inventory plots[2/] in key stands. They need not be established in all key stands at once. Only a few plots are needed in each stand, provided that they are carefully chosen to represent important condition classes. Periodic measurements and computations of the plots prior to each cut are not difficult to make. The results, moreover, are much more accurate than those obtained from borings, and they may be applied to similar stands located elsewhere.

When temporary cruise plots and borings must be used, as is often the case, it should be remembered that the information obtained is only an indication which is of temporary value. There is no one formula that can determine accurately the future behavior of a stand for very long. The simplest and quickest method, therefore, is the best. While the field man is at it, he may just as well include a simple classification of growing stock valuation. This can be done without much additional work, provided that his field tally sheet is correctly designed for the purpose. In our work involving improvement and intermediate cuttings, we use the following forms as a guide for quick determination of stocking, growth, allowable cut, and length of cutting cycle.

Form I is a tally by d.b.h. classes and a computation of basal area. The trees are tallied by two general classes of silvicultural desirability viz; "primary" and "secondary" growing stock. The former includes all trees potentially of high value and low risk, but they are not necessarily all "final" crop trees. Rather they are the trees upon which to build quality growth and from which to select final crop trees in the future.

The secondary growing stock consists of trees which should be removed from the stand in partial cuts due to low potential value and high risk. It includes trees which are poor in form, defective or of undesirable species.

Use of a multiple table speeds up the calculation of basal area.

Another point needing comment is the matter of age. This particular stand was not entirely even-aged which explains the variation. Ages are, of course, determined by an increment borer. The annual growth is the mean annual growth in basal area and is calculated by dividing total basal area by age as shown.

---

2/ Using the mapping technique suggested by Stott and Ryan (Journal of Forestry, April 1939) which we have found to be a great time saver.

Form II, perhaps, needs more explanation. The secondary and primary growing stock figures are carried forward from Form I. The liquidation period of secondary growing stock, which is decided by the man on the ground, will depend on the stand volume and the length of time such trees are needed as "fillers."

The growing stock goal is the best attainable stocking which the present stand should have at some predetermined future period. The calculation of the allowable cut is divided into three parts, namely: (1) estimated cut from the gradual liquidation of the secondary growing stock, (2) estimated cut from the gradual liquidation of the portion of the primary growing stock not needed for the optimum stocking desired, and (3) estimated length of the cutting cycle which would allow a large enough cut for commercially feasible operation.

The method gives sufficient accuracy for general marking purposes. It is simple enough to apply so that the field man can sit down on a stump and get his information in a few minutes. And it has the advantage that it can be applied to uneven-aged stands as well as even-aged.

It should be stressed once more that this method, like any other method, is only a guide. The procedure should be repeated prior to each cut.

If permanent inventory plots are used, more accurate long-term predictions can be made. In the long run, permanent inventory plots will be much cheaper than the temporary plots. They are not costly to lay out, and once they are established they will serve for a long time. The data obtained from periodic measurements, immediately before each cutting, or for other purposes, is reliable because remeasurements are on the same basis. This would hold true for large tracts as well as individual stands.

Whichever method, permanent plots or the temporary tally, is used for individual stands is immaterial, but some simple standard method must be adopted as a guide for the field men who are carrying out management on the ground. Some rangers would like to calculate their growth and cut in each stand right now, prior to marking, but they are simply too busy with other things to take the time to do it, or to sit down and figure out how to do it. Most of them would eagerly accept a simplified standard method and start using it. The application would soon make the field men think in somewhat different terms and would translate paper plans into field practice. It would result in better management, earlier achievement of the goal of well-stocked stands, and the production of quality materials to the full capacity of the soil.

Form I

Type 5c - 8c''' Date

Age 40 Name

Location SE-NW, Sec.9, T145N, R31W Measured by

Forest Chippewa Tallied by

District Blackduck Computed by

No. Plots 10 Size 1/10 acre each

| D.b.h. class | Number of trees | | Basal area | | Total age | | Annual growth (Basal area) | |
|---|---|---|---|---|---|---|---|---|
| | Prim. | Sec. | Prim. | Sec. | Prim. | Sec. | Prim. | Sec. |
| | | | Square feet | | Years | | Square feet | |
| 3 | | ——— | 2.4 | ——— | 39 | ——— | .06 | ——— |
| 4 | | | 7.8 | 4.1 | 39 | 40 | .20 | .10 |
| 5 | | | 10.2 | 5.4 | 40 | 39 | .25 | .14 |
| 6 | | | 11.8 | 6.7 | 40 | 40 | .30 | .17 |
| 7 | | | 12.5 | 6.4 | 41 | 40 | .31 | .16 |
| 8 | | | 12.2 | 5.2 | 41 | 58 | .30 | .09 |
| 9 | | | 9.3 | 4.0 | 40 | 60 | .23 | .07 |
| 10 | | | 5.4 | 1.6 | 41 | 60 | .13 | .03 |
| 11 | | | 1.3 | 1.3 | 40 | 62 | .03 | .78 |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| 16 | | | | | | | | |
| 17 | | | | | | | | |
| 18 | | | | | | | | |
| 19 | | | | | | | | |
| 20 | | | | | | | | |
| Total | 390 | 174 | 72.9 | 34.7 | | | 1.81 | .78 |
| Per acre | 390 | 174 | 72.9 | 34.7 | | | 1.81 | .78 |

Form II

## Allowable Cut (Per Acre)

| | Annual Cut |
|---|---|
| I Secondary Growing Stock = 34.7 sq. ft. | |
| Liquidation Period = 30 years | |
| Annual Growth, Sec. Growing Stock = .78 sq. ft. (From Form I) | |
| Cut: a. Liquidation = $\frac{34.7 \text{ sq. ft.}}{30 \text{ years}}$ . . . . . . . . | 1.16 |
| b. Annual Growth = $\frac{.78 \text{ sq. ft.}}{2}$ . . . . . . . | .39 |
| II. Primary Growing Stock 72.9 sq. ft. | |
| Annual growth 1.81 sq. ft. | |
| Growing Stock Goal in 40 years = 120 sq. ft. | |
| Total Deficiency (Goal - Stock.) 47.1 sq. ft. | |
| Annual Deficiency = $\frac{\text{Def.} - 47.1}{\text{Years } 40}$ = 1.18 sq. ft. | |
| Cut = Growth (1.81) - Deficiency (1.18). . . . . . | .63 |
| Total | 2.18 |

### Cutting Cycles

a. Volume needed for a feasible operation 15.00 sq.ft.

b. Annual cut 2.18 sq.ft.

Cutting Cycle = $\frac{a}{b} = \frac{15}{2.18}$ = 7 years

March 30, 1949

MANAGEMENT PLAN CONFERENCE

## TOPIC 21. POLICIES AND LEGAL LIMITATIONS AFFECTING NATIONAL FOREST TIMBER MANAGEMENT ACTIVITIES

Ira J. Mason
Chief, Division of Timber Management, W.O.

The basic statutory authority for conduct of the national forest timber business is in the Act of June 4, 1897—30 Stat. 35. This Act has proved to be a remarkably flexible and practical measure. With only a few minor amendments it has met the changing conditions of the last 50 years. This Act was the first authorization to sell timber on the then Forest Reserves. It is serving this year for the sale of 4 billion board feet with a value of $30,000,000.

The long life and the great utility of this statute is particularly remarkable in view of the conditions under which it was drafted and enacted. The story behind this Act is told in Gifford Pinchot's - BREAKING NEW GROUND. This part of Pinchot's autobiography should be required reading for every Forest Officer who wants a thorough understanding of national forest operating authorizations.

This legislation was an amendment or rider to a civil sundry appropriation act. It was drawn up to in part act as an appeasement measure for the West where there was violent antagonism to the establishment of 40 million acres of Forest Reserves by President Cleveland on February 22, 1897. Pinchot's account of the circumstances under which the measure was drawn up will dispel any illusions of supernatural wisdom on the part of its framers. Instead its continued use with but minor amendment is perhaps due to our ability to interpret and rationalize the somewhat eliptic phrases on which national forest timber management is founded.

The one sentence bearing on silviculture and management as stated in the U. S. Code (16 U.S.C. 476) is:

"For the purpose of preserving the living and growing timber and promoting the younger growth on national forests, the Secretary of Agriculture, under such rules and regulations as he shall prescribe, may cause to be designated and appraised so much of the dead, matured, or large growth of trees found upon such national forests as may be compatible with the utilization of the forests thereon, and may sell the same for not less than appraised value in such quantities to each purchaser as he shall prescribe."

One other important sentence from this Act is codified in 16 U.S.C. 475:

"No public forest reservation shall be established except to improve and protect the forest within the reservation, or for the purpose of securing favorable condition of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States."

The foregoing is all the general legislation there is bearing on silviculture, management planning and utilization policies for the national forests. The following is a regrouping and analysis of the essential thought in this legislation:

1. Securing favorable water flows. It is well to remember that watershed management is given a coordinate place with timber production as a basic purpose of the national forests.

2. Furnishing a continuous supply of timber for the use and necessities of the citizens of the United States. This is the legislative basis for sustained yield management and management planning on the national forests.

3. Preserving the living and growing timber and promoting the younger growth, and also improving and protecting the forest. These are the fundamental instructions for the practice of silviculture on the national forests.

4. Designating so much of the dead, mature or large growth trees as may be compatible with the utilization of the forests. This is the statutory language for development of utilization policies and requirements for national forest timber sales.

5. Selling in quantities as the Secretary may prescribe. (At such times and in such locations as the Secretary may prescribe is also clearly implied). Here is the language on which our cutting budgets are based. It places full control in our hands in regard to where, when, how much, and under what conditions timber is offered for sale.

6. Under such rules and regulations as the Secretary may prescribe. The power of the Secretary to issue rules and regulations and to enforce them has been a basic tool in all phases of national forest administration. This device has materially helped in establishing rules and guide lines where more detail than is available in the statutes is needed. The Secretary's regulations are an intermediate step between the basic legislation and operating instructions for use by field personnel.

Since all of the Secretary's Regulations on timber management were revised and reissued in December 1948, a brief review of them is desirable.

REGULATION S-1 is a general delegation of the Secretary's powers to the Chief, Forest Service (and who may delegate to subordinate officers) in respect to timber management matters. This is a new regulation to indicate the general concept of national forest timber administration. Under one school of thought this single regulation is all that is needed from the Secretary. The balance of the material in the Regulations could be issued by the Chief as manual instructions. Decision was reached, however, to continue the practice of publishing more detailed specifications for the conduct of our timber business. It is worth noting that these details are not required by the Federal Procedures Act since they are concerned with management of public property rather than rule making for private activity.

REGULATION S-2 covers silviculture and utilization. It is in this regulation that the phrases in the Act of June 4, 1897, are expanded into more useable form. Contrast the statutory language with the regulation which reads as follows:

"Each sale or other use of national forest timber will be authorized only after the approving officer is satisfied that practicable fire prevention measures and methods of cutting and logging are prescribed which will preserve the residual living and growing timber, promote the younger growth, reduce the hazards of destructive agencies, secure favorable conditions of water flows, and obtain as complete utilization of the various species and grades of material as the existing markets or the requirement of users permit."

REGULATION S-3 gives directions for the management planning. It is similar to previous regulation on this subject except for one important paragraph in respect to control over location and degree of manufacture. This paragraph will be discussed later at length.

REGULATION S-4 covers activity under the sustained yield unit act. Unless otherwise noted the other timber management regulations deal with actions basically authorized by the Act of June 4, 1897. Regulation S-4 is concerned with the Act of March 29, 1944.

REGULATION S-5 deals with the intricacies of conflicting claims and entries in areas under consideration for timber sales. It perhaps is worth while to call attention to the addition of certain stages of development in land exchange and sustained yield unit activity as a basis for priority of timber use over mineral or other similar entry.

REGULATIONS 6 to 18, inclusive, deal with various phases of timber sale activity. Practically all of this material has been in previous editions of the regulations. The only item which is of particular interest to a management planning group is the modification of the material which formerly appeared as Regulation S-9-(6), and is now in item (f) of Regulation S-10. This will be discussed later with the paragraph from Regulation S-3.

REGULATIONS 19-20-21 cover sales of forest products other than timber. Disposal of such material was not specifically mentioned in the Act of June 4, 1897, but is so obviously related to timber disposal that it is considered proper for inclusion as a Secretary's regulation. In addition to the long standing Secretary's regulations for sales of non-convertible products, references to such sales have been made in subsequent legislation. The most recent reference of this sort is in the so called Department of Agriculture organic Act of 1944.

The well known REGULATION S-22 for sales at cost is under a specific statute, the Act of August 10, 1912. A number of field officers have submitted suggestions that sales at cost be eliminated. It would take an act of Congress to do so. There is no prospect of obtaining such a repeal. Likewise REGULATIONS 26 and 27 for free use are based on a specific section of the Act of June 4, 1897.

REGULATION S-23 covers exchange cutting and is of no particular interest to this discussion, but REGULATIONS 24 and 25, and 28 and 29, in regard to administrative use and timber settlement do bring up an important additional principle in the management of the national forests. Aside from a very minor provision for the use of telephone poles (16 U.S.C. 560) there is no specific statutory authorization for our administrative use procedures as well as certain portions of timber settlement arrangements.

These Regulations are based on the proposition that the responsibility of public property management carries with it common sense authority to use and to control the use of the entrusted property to attain the purposes and objectives as stated in laws.

Aspects of this same reasoning have been applied in the more difficult field of control over type and location of manufacture of national forest timber. Included under this heading has been action in the interest of community support which prior to March 29, 1944, had no specific statutory recognition. The Secretary's regulations issued in December 1948 were drawn to the proposition that actions in regard to location or type of manufacture in the interest of community support should now be taken under the Act of March 29, 1944, or to state it another way, under Regulation S-4. It was realized that some of the procedures of the sustained yield unit act are awkward and that the act does not cover all types of communities where some form of regulation of location or type of manufacture may be desirable. It is our deliberate decision after much discussion with our legal advisors that this act should be considered as an expression by Congress of the circumstances under which such controls should be exercised for community support purposes. Hence if action under Regulation S-4 is not feasible, justification for control over location or type of manufacture must come from other than community support considerations.

The paragraph of new material in Regulation S-3 was written to supply a basis for exercise of control over location or type of manufacture where such action can be justified as a sound measure of property management. This paragraph reads as follows:

"When necessary to promote better utilization of national forest timber or to facilitate protection and management of the national forests, a management plan may include provisions for requirements of purchasers for processing the timber at least to a stated degree within the working circle, or within a stated area, and, when appropriate, by machinery of a stated type; and agreements for cutting in accordance with the plan may so require."

Since no circulation has yet been given to the proposed text of the manual on this paragraph, it is here inserted for discussion:

> "<u>103.8 Requirements for Processing National Forest Timber</u>. Action to require primary processing or remanufacture of National Forest timber in a specified location, or to a specific degree, which is needed <u>to protect a community or communities</u> primarily dependent on such timber may be taken under the authority of <u>Regulation S-4</u> (<u>sec. 103.10</u>).

When necessary to promote better utilization of National Forest timber or to aid in the protection and management of the National Forests, Regulation S-3 provides that purchasers of National Forest timber may be required:

a. To process National Forest timber to a stated degree within the working circle, or within a stated area.

b. To process such timber by the use of specified type or types of machinery.

Whenever requirements of either character are deemed necessary, they will be stated in the management plan, together with the reasons for the action. If the need for such requirements develops subsequent to approval of the management plan for the working circle, the proposed requirements may be submitted, for the consideration of the Chief, as an amendment to the management plan. Subsequent to the Chief's approval of a management plan, or of an amendment to a management plan, the requirements of operators stated therein may be included as conditions of sale in timber sale advertisements and agreements covering timber advertised and sold pursuant to the provisions of the management plan. Examples of requirements which may be made under this authority include, but are not limited to:

1. Manufacture within the working circle, or within a stated area adjacent to the working circle, when the timber cannot stand the expense of hauling to more distant points; or when local manufacture will permit the use of sawlogs to a smaller top diameter or shorter length, the use of inferior species, the removal of a smaller percentage of the timber stand, the operation of lighter timber stands, or other advantages to the United States, all as compared to the transportation of the raw forest products to more distant points for processing.

2. Primary manufacture outside the timbered areas, thus preventing the fire hazards caused by such operations and by the accumulation of inflammable debris, such as sawdust and slabs.

3. Processing the timber in a band mill, thus reducing saw kerf. For some types of timber or grades of logs it may be desirable to require processing by a gang saw, thus insuring utilization of timber which might otherwise be wasted. In certain cases it may be justifiable to require processing in a pulp mill or similar plant which reduces the raw material to fibers, thus providing much better utilization, or an outlet for material, such as the products of thinnings, which otherwise could not be used.

Each such proposal must be supported in the management plan and requirements of operators must be practicable and economically justifiable."

REGULATION S-10 (6) provides that award to other than the high bidder may be made if:

> "The award would result in removing or materially lessening opportunities for gainful employment to local labor; or would be against the interests of local users dependent on national forest timber; or would cause the abandonment or prevent the establishment of a local industry which would furnish a desirable permanent market for national forest products."

The manual instructions will provide that no action under this section of the regulation will be taken except by or with the approval of the Regional Forester. Advice from the Regional Attorney, and if needed from the Chief's Office, should be obtained before decision is made by the Regional Forester.

It is intended that this provision will only be used as a last resort to prevent serious and irreparable damage of the types mentioned in the regulation. The action authorized is of an emergency stop gap nature. If permanent provisions are needed and justified, they should be established and administered under REGULATION S-3 as discussed herein, or REGULATION S-4, the sustained yield unit act procedure.

Management Plan Conference

Topic 22 Management Plans for Cooperative and Federal Sustained Yield Units

L. S. Gross
Timber Management, Chief's Office

Cooperative Sustained Yield Units

Basically there is no difference between a management plan for a cooperative sustained yield unit and a plan for an ordinary national forest working circle. The outline and general form of both plans should be about the same. Ordinarily, however, it will be necessary to prepare or revise a management plan for each cooperative unit.

The first step is to compare the unit boundary with the former working circle boundary. Probably there will be some differences since the unit boundary necessarily will include the committed private lands. Perhaps the boundary changes will result in more or less national forest timber than originally was included in the working circle.

The basic data on timber volumes, areas by types, sites, age classes, etc., and existing and planned transportation facilities usually will need to be reworked in order to cover the private lands and timber as well as those in national forest ownership.

The terms of the cooperative agreement and the degree of utilization required thereby will have a bearing on the rotation, cutting cycle, methods of cutting, and cutting budget. Since the unit will be operated at sustained yield capacity to support a definite community or communities, more than ordinary care must be used in determining the allowable cut and in budgeting it. In some cases the committed private lands may be potentially more productive than the national forest lands. Although the basic silvicultural practices should be the same on both public and private lands, certain modifications peculiar to the particular operation covered by the cooperative agreement may be necessary.

Since the cooperative agreement will insure a regular supply of timber to the dependent industries, a large element of risk is removed. Every opportunity should be explored which may lead to better utilization and greater production from the land. More intensive forest practices ordinarily should be possible on a cooperative unit. Thus the harvesting plans and cutting budgets must be prepared in more detail and with greater care. The same is true of transportation plans.

(Over)

The details of the management plan should be discussed thoroughly with the cooperator and after approval he should be furnished a copy of the plan. Perhaps interested community groups may want to study and discuss the management plan.

In addition to the ordinary management plan each cooperative unit will involve a cooperative management plan. It is a supplement to the cooperative agreement in which the principles expressed in the cooperative agreement are developed into action programs. Since our experience with this type of plan has been limited to one case, perhaps the best way to develop the subject is to present the following excerpt from the current draft of the Timber Management Title of the Forest Service Manual:

> 103.22 Cooperative Management Plan. The management plan for a cooperative sustained yield unit constitutes the working tool which will direct operations on national forest and other lands covered by the cooperative agreement. It will be prepared and signed by the private cooperator and by the Regional Forester and approved by the Chief, Forest Service.
>
> Repetition of wording from the cooperative agreement will be avoided in the cooperative management plan. The foundation or supporting data usually included in a national forest timber management plan should be omitted or greatly reduced in preparing a cooperative management plan. Specific and adequate references will be made to the various sections of the cooperative agreement.
>
> The cooperative management plan will include detailed specifications, standards, and programs supplementing the principles and points covered by the cooperative agreement. It is important that the cooperative management plan express a meeting of minds on all included details of silviculture, allowable cut, cutting plans, protection, and improvements. It also will contain summaries of basic data on acreage, site quality, types, timber stands, and age classes.
>
> Private land cruises, areas, growth determinations, etc., supplied by the cooperator must be checked thoroughly by the Forest Service to insure their reliability. The prospective cooperator may make a corresponding check of the national forest lands, if he desires.
>
> If these data for private cooperating lands are obtained direct by the Forest Service, they will be gathered with the same degree of refinement as for the national forest lands in the

Unit. The cooperator should bear the cost of such work whether or not a cooperative agreement finally results.

The plan should contain a table of contents and an approval page. Each section that relates to a specific section or sections of the cooperative agreement should be headed "Prepared pursuant to section _____ of the cooperative agreement." No precise form is prescribed, but the plan should include:

a. Introduction. Reasons for the plan, and reference to cooperative agreement. Statement that the management plan supplements but does not replace the cooperative agreement and that in case of conflict the provisions of the cooperative agreement will hold.

Revision and amendment of the plan should be defined. Provision should be made for approval of revisions by the Regional Forester; amendments, including the establishment of periodic cutting budgets, to be approved by the Chief.

Ordinarily the Forest Supervisor will be designated to handle all current negotiations with the cooperator, including administration of the Unit under the terms of the cooperative agreement and the cooperative management plan, as well as maintenance of performance records and initial Forest Service action on revisions and amendments.

b. Timber Disposal, Forest Management. The plan should include needed specifications and programs, including:

A sample calculation of allowable cut, using the method prescribed in the cooperative agreement.

General order of cutting for the budget period (usually 10 years). This is not a detailed cutting budget, but a guide to needed road development.

Marking rules or guides.

Detailed cutting budget, listing specific areas and volumes (national forest and private separately) to be cut each year for a 3- to 5-year period. Rates and methods of cutting, special considerations, recreational reservations, etc. Provision for annual review, posting of accomplishments and extension of detailed plan for another year.

Specifications for cruising or for installation of permanent growth plots.
Three- to five-year program, with provision for annual review and extension.

Specifications for planting surveys and planting (or seeding). Three- to five-year programs for both, subject to annual review and extension.

Provision for maintenance of needed maps and statistical records of accomplishment on all listed activities.

c. Protection. Existing and potential areas of high hazard (such as clear-cut areas) and the measures required to reduce them. General and specific protection plans and specifications. Provision for annual review and revision.

Necessary measures and schedules for protection from diseases and insects.

d. Development. Specifications for various types of utilization roads and bridges to be built on the unit. The general road construction program for the next 5 to 10 years, showing responsibility for construction and maintenance. Detailed schedule of construction for a 3- to 5-year period, subject to annual review and addition.

Specifications and plans for other improvements, such as logging camps, if necessary.

e. Revision. At the end of 10 years, or earlier if necessary because of availability of improved data or for other good reasons.

f. Basic Data. Tabular data on acreage, sites, age classes, volumes, growth rates, etc. Any special volume or yield tables pertinent to the unit, as well as reference to published tables.

The Regional Forester should submit a draft of the cooperative management plan to the Chief for review with the draft of the cooperative agreement. After approval by the Chief, the Regional Forester will be authorized to include the plan with the proposed cooperative agreement in final prehearing negotiations with the cooperator.

Since the cooperative management plan will include definite provisions for maintenance and revision to be done jointly by representatives of the cooperator and the Forest Service, this action program will be kept current at all times. Periodically - usually at 10-year intervals - it will be necessary to reconsider the fundamental data on which the plan of management for the unit is based. This will involve recalculation of the allowable annual cut and may require more or less revision of the basic plan. Whenever this is done it will be necessary to revise the cooperative management plan accordingly. Revision or amendments of the cooperative agreement may require similar treatment.

## Federal Sustained Yield Units

The requirements and procedures for management plans on Federal units are similar to those discussed for cooperative units. The unit boundary should be compared with the previous working circle boundary. Basic data and management plan should be revised accordingly.

As with cooperative units, ordinarily it should be possible to practice more intensive forestry on a Federal unit. Plans can be much more specific than for an ordinary working circle because of the requirements for manufacture at a certain point or within a designated area.

The cutting budget and harvesting plan should be worked out in considerable detail. This can be done with the knowledge that the planned operations will proceed as scheduled, barring serious fires, insect losses, economic depressions, etc.

Definite provision is necessary for current maintenance and periodic revision of a management plan covering a Federal unit, including recalculation of the allowable cut.

It is desirable to make copies of the plan available to the people and organizations of the community which benefits from the Unit. These people should be encouraged to understand and study the management plan.

## TOPIC 23

## FORM AND PREPARATION OF TIMBER MANAGEMENT PLANS*

### 1. INTRODUCTION

All will probably agree that timber management plans should be:

a. Prepared primarily for the guidance and use of the on-the-ground unit manager, usually the District Ranger. Plans should, therefore, be prepared to take care of his needs and for continuity by his successor. It must also be recognized that reviewers and approvers will need and should have certain essential information which is obvious or well known on the ground, but is not known by those at a distance.

b. Concise, to the point, and contain no superfluous or duplicate material.

c. In such form that continuity, progress and action programs are always obtained, or carried forward, by personnel (Forest Officers) that come and go.

### 2. TYPES OF PLANS

Generally timber management plans can be divided into three groups as follows:

a. Temporary or stop-gap plans. They briefly indicate the resource status and what will be done with the resource. (See Topic 7). They are made for working circles to serve an interim period until a standard type management plan can be prepared.

b. Simple plans for working circles or management units, with little or no sawtimber, such as those in the West that contain mostly woodland species that may or may not be fully utilized.

Plans for the above two groups should be brief, contain little supporting data and go no further than to the Regional Forester for review and approval.

c. Standard timber management plans for commercial forest lands.

---

*For presentation at Hot Springs conference - March 28-April 8, 1949

Depending on circumstances, individual plans may provide for extensive management such as in the Western virgin stands, for intensive management in a few highly developed working circles, or for building up the growing stock on newly acquired lands.

The discussion which follows is confined to the standard type timber management plan as defined in 2-c above.

## 3. STANDARDIZATION AND OUTLINES

### a. Standardization

A certain degree of Service-wide standardization is desirable and necessary in the form and contents of the plan. It is the only way to insure that essential material is included and superfluous material is excluded. It will tend to prevent the inexperienced from wandering into the "trial and error" field. It will facilitate reviews. At the same time standardization must not lead to stagnation or a fixed common pattern, except possibly as to form of presentation. "Minimum requirements" more aptly describes the situation than "standardization".

Certain minimum Service-wide requirements should be insisted upon by the Chief. Regional Foresters will usually wish to add to the Chief's list, at least for special cases. Suggested requirements are discussed below under "Outlines".

### b. Service-wide Outline

An all-inclusive timber management plan outline, which will provide for covering all phases of extensive and intensive management, should be made available by the Chief. It will need to be emphasized again and again that only applicable items should be included in a plan and that the degree or scope of presentation will have to be varied to fit each case.

The management plan outline starting on page 66 of the Review Edition of "Timber Management Plans on the National Forests" by L. S. Gross fully covers the subject. The outline is briefly commented upon as follows:

(1) A. 1. "W.O." should be added so that when the plan is typed appropriate space is provided for initials in the Chief's office.

(2) C. 3. The item should be expanded to include: Allowable annual cut (by prescribed volume, species, types or areas as appropriate) with any permitted periodic variation, and length of cutting cycle.

Items A through C should as a minimum be required in all plans.

(3) Following Item C it is possible to prepare and present the plan in one of two ways as follows:

(a) To continue as Gross' outline provides with required action scattered throughout the remaining portion of the plan. It becomes necessary for the unit manager to hunt throughout a long text to determine day-to-day action. It would improve the plan if action programs were definitely set forth at the end of the various points discussed.

(b) To summarize the action program in one place which should appropriately follow Item C as Item D and be entitled "Action Program Summary". Normally, it would include in detail or by reference, a five-year action program of jobs in order of priority for the working circle or, if necessary, by defined sub-units. Appropriate items as follows would be covered:

(1) Sales or harvesting program tied to the cutting budgets.

(2) Reforestation program.

(3) Stand improvement program including prescribed burning.

(4) Insect and disease control program.

(5) Inventory (including mensurational work) program for subsequent planning purposes.

The action program would either include or provide for necessary supplemental records. Such an action program summary within the fore-part of the plan would make it easier for the unit manager to determine what needs to be done without thumbing through all the philosophy, foundation material, statistics, and conclusions each time he has occasion to use or apply the provisions of the plan. It would be especially desirable if such a procedure were followed where there is considerable cultural work to do such as in many of the Eastern working circles. For the initial harvest cut in virgin stands in the West the need for such a summary would not be relatively so important.

If a strong action program summary were incorporated as Item D in the plan, Items A through Item D could well be Part 1 of the plan and all the balance of the plan treated as an appendix or Part 2. The unit manager should, of course, be thoroughly familiar with all items in the plan but the summaries and record-keeping would serve to take care of the day-to-day needs and, therefore, best serve as a live working tool.

It is recommended the outline provide for an action program summary for optional use in the Region.

(4) Under Item D-6 - Sales Policy - any action contemplated under Regulation S-3, particularly the second main paragraph, should be covered. It would be well to add an item D-6e - "Type of Manufacture".

(5) Item D-7e - The Fire Control Outline would be clarified by changing to:

(a) Past Record

(b) Relation to Fire Plans

(c) Silvicultural Tool and/or Protection

(1) Treatment of Slash (Coop or Purchaser)
(2) Intensive Protection Measures
(3) Other

(6) There is no notation in the outline regarding a program for inventories or gathering data for use in future plan revisions. It would be desirable in many cases to set forth needs and an action program. It is recommended an Item D-7g be added to contain "Fact Needs and Program" with sub-heads: a. Status of Data Used; b. Needs for Next Revision; c. Program to Obtain.

Under D the Chief should require Items 1, 3, 4, 5, 6, 7a and 7e be included in all plans if the facts are available and appropriate. The other items will usually be included in a plan in whole or in part but they need not necessarily be required.

The items under E should be required to the extent facts and materials are available. It is well that Items E-1 and 2 be kept short and concise in a plan as they are seldom, if ever, referred to after a plan has been prepared.

c. Regional Outlines

If the Service-wide outline is complete and all-inclusive, there will be little need for supplemental Regional outlines except for clarification and interpretation purposes or to take care of special situations. Such supplemental outlines should be permitted and encouraged.

## 4. MANAGEMENT PLAN TERMINOLOGY

### a. Technical Forestry Terms

The current SAF "Forest Terminology"* should, to the extent of its coverage, be used in all management plans. The terms contained therein should be accepted and their use should be insisted on. Coining of new terms is objectionable; any clarification or the defining of new terms, if needed, should be through the SAF terminology committee.

It is recognized that there may be special situations or technical terms not defined in "Forest Terminology". If so, and they have to be used in plans, they should be defined by footnotes.

### b. Other Terms

Various glossaries should not be overlooked for definition of special terms. Cases are: Manual of Photogrammetry by the American Society of Photogrammetry and Glossary of Terms Used in Fire Control. It would be appropriate to include a list of glossary or terminology books with acceptable terms in "Timber Management Plans for National Forests".

Unfortunately, all subjects discussed in timber management plans are not adequately covered by modern terminology definitions. One of the outstanding examples is the lack of adequate terminology for utilization or harvesting roads. "Forest Terminology" or the Truck Trail Handbook does not cover the subject so as a result common usage for various terms has grown up on Forests and in Regions. When "Forest Terminology" is revised the modern adaptation of harvesting road terms should be included.

It is assumed necessary modern road terms will be defined under Topic 8 - "Transportation Planning for Timber Management Planning" and recommended for use in preparing timber management plans.

## 5. MANAGEMENT PLAN FLEXIBILITY

In the preparation of timber management plans care must be taken to avoid such rigid controls that the plan is not usable by the unit manager. Each plan needs to be sufficiently realistic so it will work on the ground and continue to provide support to dependent communities.

---

*It's out of print - a new edition is badly needed

There has been a tendency to rigidly use volume as the primary criteria for controlling the allowable annual cut regardless of the reliability of volume data. For the initial harvest cut in virgin stands volume control has been reasonably satisfactory, particularly for long cutting cycles. With lighter initial cuts and shorter cutting cycles consideration should also be given to correlating volume and area control in preparing management plans. For instance, if the cutting cycle is 20 years, 5 percent of the area should be cut over, on the average, each year. It is realized the area cut over annually will have to be adjusted to conform to the condition of the stand, the percent of cut, and volume to be removed per acre since stands vary considerable throughout a working circle. Nevertheless, the acreage cut over should be considered if the cutting cycle objective is to be attained.

For light intermediate cuts there must be considerable control by area. Volume control should be primarily to provide a reasonable flow of products for the dependent industry. Area control should be used for silviculture and administrative management in the woods with minor adjustments to provide reasonable continuity of operations.

If areas to be cut over annually are considered in the plan, data will be available as to the average annual acreage to be covered by pre-sale work including inventorying. Such data will also indicate the annual cutover acreage which will be available for KV-TSI work.

Management plans should be concise as well as flexible. They should avoid duplication with other material and plans. Data on history, physiographic items and economics can and often should be prepared for an entire national forest and included in each working circle management plan by reference. Likewise, technical items, such as forest descriptions, general policies, marking rules, sale area betterment and treatment of slash, can be referenced to acceptable national forest or Regional policies, plans or instructions. Similarly, other available Forest or unit resource management plans can and should be appropriately included by reference, particularly recreation, range management, water management, wildlife management and fire control plans and, in addition, transportation plans. Full advantage should be taken of other resource plans and Forest-wide or Regional material in order to keep timber management plans concise, workable and flexible.

## 6. MANAGEMENT PLAN PREPARATION

Timber management plans are usually revised each decade. Seldom has the same Forest officer had an active part in an individual plan more than once. Usually, a Ranger will actively participate in the preparation or revision of a timber management plan only once in his lifetime. It must be recognized, in discussing the preparation of management plans, that there has been no continuity of personnel or of experience. It usually has been an inexperienced man on his first and only job of its kind (for him).

The question resolves itself to that of how best to prepare acceptable timber management plans the most effectively and economically.

The planning job consists of bringing together all available information, analyzing the facts, setting objectives and giving consideration to policies and regulations and then, like a puzzle, take the small pieces and fit them together in a plan or action program. Preparation of a plan for a working circle is a summary, together with what general guides may be necessary in the way of policy, technique, dependency, etc. which added together will spell what can be done toward reaching certain desirable objectives.

Actual planning is an on-the-ground job, i.e. the plan can best be put together near the source of material and by local Forest officers who are the best informed. It should be a general rule that the man most familiar with the detailed conditions within the working circle should take the lead in writing the plan. If he is not qualified as a writer, he should at least sit at the elbow of the person who puts it together.

Plans have been and can continue to be prepared in one of the following ways:

a. <u>District Ranger</u>

If he has been on the District long enough to be thoroughly familiar with the local conditions and the working circle is wholly within his Ranger District, he should take the lead in plan preparation, if he is qualified to do so.

b. <u>Forest Staffman</u>

If the working circle involves more than one Ranger District or the District Ranger is not familiar with conditions or is not qualified the Forest staffman, assigned timber management, should usually take the lead in plan preparation.

c. <u>Regional Technician</u>

If neither the District Ranger or Forest staffman is qualified to do the job, or for Cooperative Sustained Yield Units or for especially important cases, a Regional planning technician will usually be assigned to take the lead in plan preparation.

d. Task Force

A planning task force can be handled in one of two ways:

(1) Forest: The most qualified Forest officers on the Forest would get together and do the job on a project basis. Usually the task force will consist of the timber management staffman, the District Ranger and one or more P-1 or P-2 foresters (fact finders and compilers). Generally, this system is being followed, is effective and merits consideration.

(2) Regional: In some cases the task force can be expanded to include one or more from the Regional Office for doing the job on a project basis. On especially important cases or for the purpose of keeping informed or providing leadership and training, this system merits occasional use. Occasionally including the staff planner from the W.O. Division of Timber Management would also be helpful to all concerned.

There should be no insistence that all plans have to be prepared by one and only one method. All have merit for certain cases. It is recommended, however, that the following be carefully considered for each case:

(a) A local qualified Forest officer prepare or sit in on plan preparation in contrast to doing the job on a mass production basis by Regional technicians.

(b) The task force method be used except for relatively unimportant cases. The main advantage of this method is that the task force can assemble at a place where they will hot be interrupted and can do the job on a project basis.

In all except minor cases, and regardless of the method used for preparation, it is desirable to hold a planning conference in advance of actually initiating the planning job. For most cases the Forest Supervisor, Forest staffman and District Ranger(s) should be the key conferrers. For important cases a Regional representative should sit in on the conference. If the planning job is to be done by a task force, the first step would be the conference; the Forest Supervisor should, of course, be available to take the lead during the conference. At the conference major objectives, land use coordination, assignments and a preparation program should be discussed and decisions made.

7. MANAGEMENT PLAN REVIEW, COORDINATION AND APPROVAL

a. Rough Draft

After the rough draft is available the first thorough and basic review and coordination should be by the Forest Supervisor, He should give especial attention to coordination with other resource uses, action programs and relation to local economy. Any revisions should be incorporated in the review edition. A copy of the review edition should be sent to the Regional Forester for review by the interested Divisions as a check on the Supervisor's judgment, accuracy, and adequacy of planning. The review edition should be returned with comments to the Forest Supervisor for final editing and typing.

b. Final Edition

After the final edition is signed on the Forest, it will be submitted to the Regional Forester for final review, initials by interested Divisions, and approval before transmittal to the Chief for review and final approval.

It is recommended the Chief authorize the Regional Forester to give final approval to minor and relatively unimportant plans. The formula for final approval by the Chief and by the Regional Forester should be somewhat as follows:

(1) The Chief give final approval to all plans involving Federal Sustained Yield Units with an allowable cut of over 5 million board feet and to all those involving Cooperative Sustained Yield Units.

(2) The Chief give final approval to all important plans which could well be based on the size of the allowable annual cut (see (3)).

(3) The Chief authorize, except for Sustained Yield Units as covered in (1), the Regional Forester to give final approval to all plans with a planned allowable annual cut of 5 million board feet or less and to all those where the allowable annual cut is 20 percent or less of the timber sale authorization. For instance, Regions with a sale authorization of 50 million board feet could approve plans with an allowable annual cut of 10 million board feet or less. Copies of approved plans should be submitted to the Chief so his file will be complete.

It takes time and costs money to review and approve a plan in the Chief's office. The time saved, by not formalizing action on the relatively unimportant plans, could be profitably used by the planning staffman, in the W. O. Division of Timber Management, by spending more time in the Regions reviewing plans on the ground, by providing leadership, by training and by sitting in on planning conferences.

## 8. COST OF PLAN PREPARATION

So far as known, detailed time and cost studies have not been made for the preparation of timber management plans. A rough estimate for a single plan for salaries and expenses would probably be within the following range for the preparatory steps only (does not include inventories, mensurational studies or other field work or permanent record-keeping):

| | |
|---|---|
| On the Forest .................... | $ 600 to $1,000 |
| In the Regional Office ........... | 125 to 200 |
| In the Chief's Office ............ | 50 to 100 |
| Total per Plan .......... | $ 775 to $1,300 |

If plans are made or revised for the 688 working circles, once each decade (conservative) it would then cost from $53,320 to $89,440 per annum Service-wide for preparation. Since many plans are revised oftener than once a decade, it would be safe to say that the cost of plan preparation (office only) will be about $100,000 per year.

Topic Assignees:

Lindh - R-3

Tabbutt - R-7

Region 8

# TIMBER MANAGEMENT PLAN
# OUTLINE

I. Title and Approval Page.

II. Summary Page.

III. Timber Management

- A. Introduction.
- B. Program for period beginning____(date)_____ and ending_(date)_
    1. Objectives.
    2. Correlation of timber management with other land uses.
    3. Forest Practice.
        - a. Digest for natural stands by each broad type.
        - b. Digest for plantations.
    4. Regulation of Timber Use.
        - a. Subdivision of working circle.
        - b. Digest of basis for regulation.
        - c. Calculation of allowable cut.
        - d. Cutting budget and plan.
        - e. Cutting records.
    5. Schedule for timber stand improvement work, planting, prescribed burning, timber surveys, and remeasurement of permanent plots, special fact-finding projects,

IV. Protection.

Program for period beginning____(date)___and ending_(date)____

1. Fire.
2. Disease and insects.
3. Grazing

V. Development.

Program for period beginning____(date)___and ending__(date)____

1. Roads.
2. Land acquisition and exchange.
3. Socio-Economic.

VI. Appendix

Timber Management Plan for Period

beginning ___(date)___ and ending ___(date)______

________________ Working Circle

________________ National Forest

Region 8

Submitted ___(date)___ by ___________(Name)___________, _____(title)_____

Approved ___(date)___ by ___________(Name)___________, Forest Supervisor

Reviewed and recommended for approval by Regional Office Divisions:

Timber Management ____________________

Lands, Recreation, Wildlife, Watershed Management ____________________

Fire ____________________

Engineering ____________________

Approved ___(date)___ by ___________(Name)___________, Regional Forester

Approved __________ by ___________(Name)___________, Acting Chief, Forest Service

Washington Office Divisions:

Fire Control ____________________

Forest Management Research ____________________

Recreation and Lands ____________________

Watershed Management ____________________

Range Management ____________________

Timber Management ____________________

Wildlife Management ____________________

## SUMMARY

Location: List counties and state in which working circle is located.

Area of National Forest Land as of (date) ___________.

| | | |
|---|---|---|
| Non-forest land | ___________ | acres |
| Non-commercial forest land | ___________ | |
| Commercial forest land | ___________ | |
| Total | | acres |

Net Merchantable Volume Commercial Forest Land as of (date) ______

| | | |
|---|---|---|
| Pine (size class) | ___________ | M cords (128 cu.ft.) |
| Hardwoods - Cypress (size class) | ___________ | |
| | =========== | |
| Total | ___________ | M cords(128 cu.ft.) |
| Pine (size class) | ___________ | MBF, Scribner |
| Hardwoods - Cypress (size class) | ___________ | |
| | =========== | |
| Total | ___________ | MBF, Scribner |

Periodic Annual Growth for Period, (date) to (date) ____________

| | | |
|---|---|---|
| Pine (size class) | ___________ | MBF, Scribner |
| Hardwoods - Cypress (size class) | ___________ | |
| | =========== | |
| Total | ___________ | MBF, Scribner |

Allowable Annual Cut for Period, (date) to (date) ____________

| | | |
|---|---|---|
| Sawtimber: Pine | ___________ | MBF, Scribner |
| Hardwoods - Cypress | ___________ | |
| | =========== | |
| Total | ___________ | MBF, Scribner |

Minor Forest Products:

## TIMBER MANAGEMENT

Introduction

Brief and concise statement of the relationship of the proposed plan to previous plans, if any, and/or timber management of area included in working circle.

Program for Period beginning (date) and ending (date) ____________________.

1. Objectives.

(1) To manage the timber stands primarily to grow trees of a size and quality required for sawlogs.

(2) To build up the growing stock in the amount of ________ MBF of pine sawtimber on ______________ operable acres and ______ MBF of pine sawtimber on ___________ inoperable acres.

(3) To conduct (regeneration and/or intermediate) cuttings over ______________ operable acres.

(4) To contribute to the stability of communities and opportunities of employment by selling, cutting, and removing the allowable annual cut of __________ MBF of pine sawtimber; __________ M cords of pine pulpwood; etc.

(5) To conduct stand improvement work over __________ acres.

(6) To plant __________ acres with (species) ______.

(7) To obtain estimates of the net merchantable volume and increment during the period, (date to date).

(8) To prepare and submit to the Chief, Forest Service, prior to (date), a revised timber management plan.

2. Correlation of Timber Management with Other Land uses.

A. National Forest lands on which timber growing for primary forest products is not the dominant use.

The dominant use may be grazing, recreation and roadside zones, water, wildlife, special uses, administrative use, experimental forests, etc. List each area and its dominant use, show general location on working circle map. Refer to pertinent sections of approved plans in other fields of land use; i.e., recreation plan, or to approved forest or regional policies for timber use program.

B. National Forest lands on which timber growing for primary forest products is the dominant use, and other uses are secondary.

Other secondary uses may be grazing, recreation and roadside zones, water, and wildlife. List secondary uses. If any such uses are localized give general location in terms of compartments involved. General statement of principles and policies in regard to corre-

lating timber use with other secondary uses as applied to the working circle covered by the plan.

(1) Grazing (see NF-C2-8)

   (a) Exclusion of livestock at critical periods to gain natural reproduction or aid plantation survival.

   (b) Maintain open areas: old fields, sawmill sites etc.

   (c) Protect stock during timber stand improvement work.

(2) Recreation and Roadside Zones (See NF-G-3 Page 20)

(3) Wildlife (See NF-D2-15)

   (a) Openings in forest cover.

   (b) Timber stand improvement instructions.

   (c) Protection of live streams for fish.

   (d) Stream pollution.

   (e) Brush disposal.

(4) Water

   (a) Adequate forest cover after cutting.

   (b) Preservation of stream bed, and stream bed vegetation.

   (c) Contamination.

   (d) Requirements to reduce erosion of logging roads, skid trails, etc.

3. <u>Forest Practice</u>

A. <u>Digest for natural stands for each broad forest type. (Shortleaf, Loblolly - Mixed Hardwoods) Forest Type.</u>

   (1) Area and/or proportion of working circle occupied by type.

   (2) General location and sites occupied.

   (3) Character and condition of timber stands.

   (4) Major and minor forest products.

   (5) Methods of cutting.

      (a) Applicable regeneration systems.

      (b) Applicable intermediate cuttings.

(6) Timber stand improvement work and K.V. collections (principles and policies).

(7) Permissible logging methods.

(8) Reduction of fire hazard (principles and policies).

(9) Reduction of losses and damage from insects and disease.

(10) Utilization practice (principles and policies).

(11) Marking rules(principles and policies, details in Appendix. Tie in with correlation with other land uses).

B. Digest for Plantations

(1) Area and/or proportion of working circle occupied by plantations.

(2) General location and sites occupied.

(3) Character and condition.

(4) Major and minor forest products.

(5) Methods of cutting

(a) Applicable regeneration systems.

(b) Applicable intermediate cuttings.

(6) Timber stand improvement work and K.V. collections (principles and policies).

(7) Permissible logging methods.

(8) Reduction of fire hazard.

(9) Reduction of losses and damage from insects and disease.

(10) Utilization practice.

(11) Marking rules.

4. Regulation of Timber Use

A. Subdivision of Working Circle

(1) Land Units - Block, compartment (show on map)

(2) Forest Units - Working group, stand.

B. <u>Digest of basis for regulation by each working group</u>.

(1) Volume required for economic logging.

(2) Factors affecting removal of timber: roads, weather.

(3) Markets - kind and amount of forest products.

(4) Dependency on national forest timber.

(5) Problem species and/or products.

(6) USFS sale history by compartments, and estimate when each compartment will be ready for a return logging operation for cutting sawtimber and minor forest products.

(7) Timber stands operable under cutting practice: area, net merchantable volume, and increment.

(8) Timber stands inoperable under cutting practice: area, net merchantable volume, and increment.

C. <u>Calculation of Allowable Cut by each working group</u>.

(1) Basis: operable stands, certain species or all species, sawtimber or all products.

(2) Method.

(3) Allowable cut.

D. <u>Cutting Budget and Plan</u>.

(1) Show fiscal year when cutting operations are to begin and be completed in each compartment.

(2) Sequence of sales: sawtimber sales and minor forest product sales.

(3) Material chargeable to cutting budget; material not chargeable to cutting budget.

(4) Relation of size and kind of sales to cutting budget.

E. <u>Cutting Records</u>.

List cutting records and maps to be maintained, and purpose of each.

<u>5. Schedules</u> - for timber stand improvement work, planting, prescribed burning, timber surveys, remeasurement of permanent plots, special fact-finding projects. Set up 3-year schedule for each class. List area to be worked over by compartments and fiscal year of working. Each fiscal year prior to May 1 review compliance and accomplishment, adjust schedules for next two years and develop schedule for additional year. After approval by Regional Forester, copies of revised schedules will be inserted in plan.

## PROTECTION

Program for Period beginning (date) and ending (date) .

A. Fire

Give objectives, scope, and extent of program necessary to produce successive crops of timber and reduce loss and damage to existing growing stock.

(1) Allowable burn.

(2) Protection of areas of extra hazard (sale areas).

(3) Prescribe burning for hazard reduction. Tie in with Forest Fire Plan.

B. Disease and Insects

Give objectives, scope, and extent of special projects; (prescribed burning for brown spot control, etc.)

C. Grazing

Fencing program and/or closure program to exclude stock at critical periods to gain natural reproduction or aid plantation survival. Tie in with Forest Grazing plans or policies.

# DEVELOPMENT

Program for Period beginning (date) , and ending (date) .

A. Roads

Give objectives, scope, and extent of program necessary to obtain removal of forest products. Tie in with Forest Transportation Plan or Road Plan, and policies dealing with maintenance and construction of roads by purchasers of national forest timber.

B. Land Acquisition and Exchange.

Give objectives, scope, and extent of program as related to timber management on acquired land. Tie in with Forest Land Purchase and Exchange plans or policies.

C. Socio-Economic

Timber uses are to be planned so as to obtain, so far as possible, stability of employment, homes, and communities. This does not necessarily require the establishment of sustained yield units under the Act of March 29, 1944. Give the objectives, scope, and extent of the program. Tie in with the timber management section of this plan, and forest plans or policies dealing with community support.

# APPENDIX

1. Physiographic features of working circle: topography, soil, climate.

2. Timber Resource Data: area, volume, increment by stand classes etc.

3. Socio-Economic Data:

   a. Brief description of each community, location, population, transportation facilities, economic activities supporting community, dependency on timber processing operations.

   b. List of timber processing operations: name, location, kind of plant, products produced, annual requirement for primary forest products, dependency on N.F. timber.

   c. Table showing flow of National Forest timber cut for processing to each of the communities.

4. Timber Management: Digest of pertinent facts relative to timber management on the working circle for period prior to proposed plan.

   a. Date of establishment of working circle and national forest.

   b. Timber management prior to first policy statement or timber management plan.

      (1) Timber resources: character and condition, net merchantable volume.

      (2) Timber use: limitation of cut, if any, method of cutting, area cutover, volume cut, principal products.

      (3) Planting: area planted, species planted.

      (4) Stand improvement work: Character of, area worked.

   c. Timber management for each period covered by policy statement or timber management plan.

      (1) Date of policy statement or timber management plan and period covered.

      (2) Timber resources: character and condition of timber stands, net merchantable volume, increment.

      (3) Timber use: allowable cut, method of cutting, area cutover, volume cut, principal products.

      (4) Planting: area planted, species planted.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

(5) Stand improvement work: character of, area worked.

5. Protection: Digest of pertinent facts relative to fire, disease and insects, grazing, storm damage etc., having a bearing on timber management for period prior to proposed plan.

6. Development: Digest of pertinent facts relative to road, land acquisition, and exchange programs USFS and private, consolidation of ownership, socio-economic developments having a bearing on timber management for the period prior to the proposed plan.

7. Map - of suitable scale showing boundary of working circle, compartment boundaries, national forest land, roads and roadside zones, and major physiographic features.

## TOPIC 24

## CONTROL RECORDS, HARVESTING PLANS, TIMBER MANAGEMENT

## PLAN REVISION

By Paul A. Grossenbach

To begin, I wish to thank Austin Hasel of Region 5 and Albert Sump of Region 9 for their help on this topic. Much of the material regarding present practices in this paper they will recognize as their own.

### Control Records

Control records are needed to determine the results obtained under management, the costs and returns of management, and for planning future action. The records kept should be limited to essential items, for each of which the method of putting the information to use is definitely known beforehand. Obviously the records should be as simple as possible for practical maintenance and usability.

The failure to provide for and maintain this simple record of accomplishment has been the weakness of many management plans in the past.

What control records should consist of and how they should be kept can probably be shown more easily by a review of some of the methods in use at the present time than in any other manner.

### Present Practices

#### Region 5

In general, the system now in use requires a listing of data obtained from the timber sale reports, a working circle map and cutover cruises.

From timber sale reports the following information is obtained:

- Area cutover by G.L.O. subdivisions
- Method of marking used and who did it
- Summary of cut and leave plots
- Summary of scale by species, including number of species, merchantable scale, and cull percentages.
- Stumpage prices and receipts
- Felling and other logging damage.
- System of logging used.
- Brush disposal
- Disposal of snags and diseased trees and amount utilized.
- Operating costs.
- Map showing area cut over and rail and truck roads used and constructed during the season.

The working circle maps show the following:

- Boundary of working circle
- Sale boundaries
- Government land cut-over to date.
- Boundaries of areas 100% killed by fire.
- Existing railroads and all passable roads.
- Completed land exchanges

Cutover Cruises

These were originally 10% cruises which were found too burdensome to keep up to date and about 1940 a 1% cruise was adopted as standard, on the basis that estimates would be accurate within 10% when the accumulated cutover area reached 10,000 acres. The primary objective of the cruise was to collect data for the prediction of growth, and permanent sample plots representing average conditions were set up for periodic remeasurement. Cruises by this method are far from being up to date and the Region now proposes to use the continuous inventory system which has been previously discussed for the collection of these data.

Recommended Practice, R-5

All working circles should be subdivided into compartments, and records kept separately by compartments instead of sale areas.

Data essential to the management record should be abstracted from sale reports and filed in the compartment record. Likewise any non-sale cutting should be summarized and included. The sale data should be segregated by allocated and unallocated cut.

Compartment cruise data taken before logging, and periodically after logging should be summarized by stand and stock tables and compared with the balanced stand and stock charts set up as the goal necessary to claim that the stand is regulated.

Results of periodic reexamination of permanent line samples to show condition with reference to restocking and brush cover will be listed.

Summaries of stand improvement work, Ribes eradication, insect control, and planting, together with maps showing areas affected, are to be included.

Each compartment should have a supply of overlay skeleton maps for adding new map data.

Observations on compartments where present logging or other activity is nil, should be noted regarding mortality, development of poor risk volume, and other useful information.

Present Practice, R-9

The Region is now in the process of revising all management plans and expects to complete the job within the next ten years. The first step in the revision of the plans is to prepare a good timber type map by use of aerial photos. This map will show timber type, size class and density, and will be used in harvest planning and for recording accomplishment. Area regulation, with volume as a check, will be used in regulating the cut as each working circle plan is revised. An allowable cut will be established for each major timber type. Consequently, control records must be devised that will be simple to maintain and the kind that will provide the forest manager with a record of proposed and accomplished cutting in conformity with the prescriptions of the management plan. Also the control records must be so maintained that the information recorded will be useful in future revisions or harvest planning at the start of each new cutting period.

The control records to be used consist of a timber type map (2" to the mile scale), a form for preparing the annual sales program, and a form for recording area sold and cut by timber type as well as volume by products. Samples of the forms and maps are here and I will pass them around so that all who desire may see them. Sample entries have been made on both the forms and the map.

Specifically, the records will be maintained as follows:

Map

At the start of each new cutting period, a cutting budget by years for the initial three-year period will be outlined on a timber type map using a legend that will show the year to be sold and eventually the year cut. Ten colors will be used each representing one year of the period. Thus red may be selected as the color for year 0. If the sale was sold and cut in 1950, it would be shown in red according to the legend for sold and cut. If it was sold in 1950 and cut in 1953, it would be indicated by red for the year sold and by the selected color for the year cut. At the beginning of each new period a new set of maps will be used with each year of the new period bearing the same color as the past period. Thus one will speak of the "red year", "black year", etc., depending upon the color scheme selected. By use of the color scheme the map properly filled out will show harvest planning and the year each area was cut. This is an important record when short cycles are in use.

Annual Sales Plan - Form 78 R-9

Each year an annual sales' plan will be prepared for each working circle. This plan will show each cutting area scheduled for cutting and the area by timber types to be cut. It will also show the volume of the important species and products scheduled for cutting as well as the estimated amount of K.V. funds to be collected from each area. Each cutting area will be tied in to the management maps by use of a number. This method follows the compartment system quite closely with the exception that cutting area takes the place of compartment.

Permanent Timber Control Record - Form 77 R-9

This form will be used to record the sold and cut progress by area for each regulated timber type as well as to record the sold and cut volume and value by products for preparation of the 949 Quarterly Cut and Sold Report. Data from each sale will be recorded and will be tied to the map by the "area number", which is the number assigned to each cutting area. It will, therefore, be possible to compute, if necessary, the volume removed from any individual cutting area.

In addition to the above, the maintenance of a correction map for use in the preparation of a new map and for scheduling cutting in the next cutting period, is believed highly desirable. Changes in timber type and condition class will be noted after cutting as well as any changes in cultural features such as the construction of new roads and other improvements. Land lines will also be corrected if found to be in error.

Present Practices R-8

The timber management control records currently in use consist of the following:

A map of the working circle on which the general location of the timber sales are shown.

Customary timber sales records.

Annual sales plan, Form TM-148-R8

The 949 work sheet, TM-149-R8.

Perhaps they may take objection to my statement, but there seems to be some similarity between the methods in use in at least two of the eastern regions. How any of the systems described work or will work I do not know. I merely listed the information as given to me, for informational and comparative purposes which will be shown later.

Up to this point this paper has been concerned only with practices in use or proposed for use in the Regions mentioned. It might have been shortened but I did not wish to delete anything that might change the meaning. From here on there may be some repetition but, in all fairness to Messrs. Hasel and Sump, I will say that due to lack of time, they have had no chance to review the following statements and therefore they may or may not agree.

From a review of past practices there are a few obvious deductions that can be made.

1. The need for control records is well established.

2. The type and amount of data recorded will probably vary

with regions because of different species, products, management practices, etc., and therefore cannot be standardized for all regions, but there may be a place for some standardization for groups of regions.

3. The form of recording data will vary for the same reasons.

4. There is more to control records than more records of cut, tabular and graphical, but the annual maintenance of control records is primarily concerned only with these and they are of major importance.

5. The more intensive the management the more factors become involved in control records but along with intensive management come better inventory data and better growth data, placing management on a firmer basis, thus tending to take some of the responsibility for revision from control records.

The Components of Control Records

I- VOLUME RECORDS

1. Regulated volume cut by species (and products) which can be further broken down by allocated and unallocated cut, cutting not budgeted such as salvage cutting, individual sales, etc.

2. Non-regulated volume cut, also by species and products (this includes thinning).

3. Losses, not salvageable, such as fire and insect killed timber in the regulated area which for any reason cannot be salvaged. (These will in most cases be estimates).

II-AREA RECORDS

1. Regulated area cutover (by types if regulation is by types).

2. Non-regulated area cutover.

3. Area of timber producing land lost through any causes, such as fire, withdrawals, etc.

4. Area gained through any causes, such as planting, acquisition, road construction, opening up inaccessible areas, etc.

5. Other cultural work kept by area, such as prescribed burning, pruning etc.

These, I believe, are the main components of control records, although I may not have every small item listed.

I have purposely not included in the above list any inventory data. Technically, I suppose stand changes as shown by inventory could be included as control records but such records are primarily for use for revision purposes (after the first plan has been made) and are not listed for that reason.

## The Use and Value of Control Records

Needless to say, it is impossible to put down here how much of the above should or should not be included in any plan. The simplest records that will serve the purpose should be the aim, and these will vary even within regions.

The immediate use of control records is of course to see if you are on the way to where you started out to go. For this purpose straight volume control is known to have failed and it is my contention that it alone is useless with anything less than highly accurate small area inventory data. Regulation by major types and regulations by area further complicate the matter.

To tie the plan to the ground then, some area records are necessary. The simplest of these is, of course, the timber type map, and the better the map the more positive the control. The map affords a visual check on progress that even the best volume records cannot show. The two together become an invaluable aid in checking for inconsistencies between the actual and the planned and making immediate corrective action possible. They may be all that are needed for a short-term check.

The accumulation of control records over a period of years is needed for plan revision purposes and will be taken up later in this paper.

A summary form for the posting of the required data, such as those in use in Regions 8 and 9, is practically a necessity for any plan. Nearly every active working circle will have more than one operation requiring posting at stated intervals. In any case this work should be done annually, but oftener if necessary because of volume handled. For annual posting, the time of closing timber sales is suggested as a possible date. If neglected, the records are soon filed away and forgotten, and when a later effort to assemble the data is made, the task assumes major proportions. Maintenance of the unit progress map is included as a part of the above-mentioned posting of records.

## HARVESTING PLANS

For the purpose of this discussion I have borrowed the Region 3 "Outline for Timber Harvesting Plans." As far as I know it is the most complete outline in use by any of the Regions at the present time. In fact, it is the only one I was able to secure sufficient information about to present as a part of the "present practices" section of this topic. It is, therefore, reproduced in full below:

## OUTLINE FOR TIMBER HARVESTING PLAN - R-3

Objective - as a supplement to the approved forest management plan, to prepare a harvesting plan for five years ahead which will: (1) delineate future sales areas; (2) provide a base for advising prospective purchasers of the sales program; (3) develop inventory of pre-sale needs including engineering work and an action program for accomplishing same; (4) serve as a base for annual monthly work plans and allotment of funds. It will provide the orderly base for marketing and harvesting timber instead of being pushed by the purchasers. It will be revised as necessary each year for the succeeding 5-year period.

Unit to Consider - ordinarily a major working circle with a summary for the Forest.

### OUTLINE FOR PREPARING PLAN

1. Name of Forest and Unit

2. Basic Source Data

   a. Area by types
   b. Volume by species
   c. Approved cutting budget
   d. Average cut past five years.
   e. List of established operators or prospective purchasers with annual cut of each. Show location of each by reference number of map.
   f. Prepare one-inch-to-the-mile base map of Unit to show Unit boundaries and data called for in outline.

3. Sales Program - delineate each proposed advertised sawtimber sale on the map by a green line. Consecutively number each sale area in green. Then make a list with the following headings:

   a. Map reference number
   b. Name of proposed sale
   c. Total volumes by major species
   d. Percent to be cut
   e. Volumes to be cut by major species
   f. Volume to be cut each year and number years sale will be for.
   g. Date sale should be made - month and year

h. Name of prospective purchaser or purchasers.

i. Inventory and pre-sale work -

(1) Area to cruise

(2) Date to cruise (preferable two years in advance)

(3) Percent of intensity of cruise

(4) Man-days to cruise (including compilations, preparation 2-inch-to-the-mile type and sale map).

(5) Date of road location by competent engineer or locator (including staking center location, written specifications and cost estimate for all main and branch roads. Show all such proposed roads on the map in red - solid line for main and dashed line for branch. Should be done at least one year in advance of making sale).

(6) Estimated number miles of road to locate.

(7) Estimated number of man days to locate roads.

(8) Date for examining area and preparing pre-sale report and appraisal. (Should be done as soon as all inventory data are available).

(9) Number man days to examine area and prepare pre-sale and appraisal report.

(10) Remarks.

The list should be at least triple spaced. There will then be space to make pencil progress entries after each job is accomplished or to make revisions from year to year. Each year the list to be brought up to date by adding an additional year.

If there is more than one major working circle for the Forest, a Forest summary should be made each year with headings about as follows:

| Item | 1948 | 1949 | 1950 | 1951 | 1952 |
|---|---|---|---|---|---|
| 1. Area to cruise (acres) | | | | | |
| 2. Man-days to cruise | | | | | |
| 3. Miles of road to locate | | | | | |
| 4. Man-days to locate roads | | | | | |
| 5. Man-days to examine area and prepare appraisal. | | | | | |

4. Mechanics - preferably prepare on letter-size sheets but it will be acceptable to prepare on atlas size sheets and file with map in Timber Atlas Control Record binder. Copies should be made for the Ranger, Supervisor and Regional Forester.

***********

I believe the R-3 outline is complete enough in itself that little further consideration of the composition of harvesting plans in general is merited. Some consideration should be given, however, to the need for harvesting plans and their utility in management.

A harvesting plan is an immediate unit action program. It differs from the cutting budget in this manner and also in its consideration of other factors besides the allowable cut. Certainly with a well-prepared meaningful harvesting plan in his hands no forest manager will be caught unprepared in his handling of the sales program.

I should mention here that the R-3 outline was not meant to be set up for a model. Some such plan is necessary, however, for the disposal of forest products and no doubt has been carried in the heads of most forest managers in the past. The written plan is a business-like program to obtain the general objectives set up in the management plan.

The needs for harvesting plans will vary. For the intensive management and well-roaded working circles of the eastern regions, an annual sales plan alone will probably suffice as at least part of the problems of the harvesting plan are already solved. Whether the detail shown in the outline above is needed for most western working circles is beyond my ability to say. I merely recommend the plan for consideration by all attending this meeting.

## MANAGEMENT PLAN REVISION

### Current Accumulation of Revision Data

It is generally agreed that the collection of revision data in the past has not been entirely satisfactory. For one reason, the intensity of the field data collection was too burdensome, as in the case of cutover surveys. Another reason was unsatisfactory collection and recording of drain - especially for sales.

A detailed report of past practices cannot be made with the data I have available. Such a report might have considerable guidance value in plotting new courses. I am sure, however, that each Region is aware of the shortcomings of its own plans and procedures. It appears that much has been required but little has been done. I will hazard a guess that the reason has been the same in most cases. The systems required made adequate collection of data economically impossible of achievement.

In brief, what are needed to keep plans alive and to maintain them as working tools are:

1. Field work for gathering records of change that is both practical and economical and consisting of:

   Current sampling data as gathered on various surveys within the working circle.

   Basic resource data from permanent working plots, mortality strips, Forest Survey plots and maps, etc.

   Pertinent considerations include:

   Net growth and mortality

   Check of cutting cycle against growth on residual stands.

   Success in restocking with desirable species since the previous cut.

   Degree of progress toward the balanced growing stock of a regulated stand.

2. Record keeping which combines brevity with necessary completeness (Control Records).

   Pertinent considerations include:

   Correction of area and estimates to take into account land acquired by purchase or exchange.

   Correction of area and estimates to take into account changes of type and losses as from fire, wind, insects, diseases, etc.

   Set up of cutting control records so information recorded can be used in revisions with a minimum of effort and confusion.

Control records have been covered in the first part of this paper so the remainder of this discussion will be limited to the collection of field data.

## Proposed Practices

### Region 5

The Region 5 system of continuous inventory has already been mentioned in this paper and by now should have been thoroughly covered in topic 12. In addition to the inventory system mortality is cruised on a 1-acre plot that included the growth inventory plot. These, together with Survey data, are expected to provide estimates of actual net growth and mortality.

Region 4

Region 4 expects to rely on permanent sample plots (but not randomly selected) and mortality strips for the same information.

Permanent plots and strips provide for measurement data to guide management practice. They promote interest in the job for the forester on the ground. No doubt they have a prominent place in our work in western regions.

Region 9

Region 9 is thinking in terms of keeping revision data in the form of a correction map and a cutting progress map which no doubt will have been explained by this time by Mr. Sump. The Region expects to prepare new maps from aerial photography about every 10-20 years, depending on conditions.

## CONCLUSIONS

It would be useless for me to attempt to inject any recommendations concerning methods of obtaining field data to keep plans alive, through the media of this paper. The subject is best covered in the discussions at this meeting. Certainly the short resumé of proposed practices given above points to the need for leadership and guidance in the matter by the Washington Office and research. We will need some "trial and error" to meet Regional conditions, but it should be minimized by as much Service-wide guidance as possible.

## TOPIC 25 - THE VALUE AND USE OF TIMBER MANAGEMENT PLANS AS A PUBLIC RELATIONS TOOL

We try to achieve the greatest good for the greatest number. We believe that our intentions are good, that our objectives are high, and that our skill is considerable in making and applying management plans. We firmly believe that we are working for the good of the people. Nevertheless, these same people may have little knowledge of our intentions, objectives, and skills. Lacking this knowledge they may be critical, suspicious and hard to get along with. Our high ideals get us nowhere unless we can convince others that we have their interest at heart.

From years of our own publicity, as well as from newspapers, novels, stories, and Hollywood's films, the public has learned about forest fires. Planting is also understood to some extent. Beyond that there is little understanding or appreciation of what a forester can possibly be doing when he is not fighting fires or planting trees. It is a common experience to drive a Forest Service car to a gas station and be asked about the fire situation or about a planting job. It is a rare day that a layman asks us about any of the other important jobs connected with growing, managing, harvesting and marketing crops of timber.

Up to now the Forest Service has been the custodian of a storehouse of timber and other natural resources. That, at least, has been true in the West. Witness the experience with the word "preserves" as applied to national forests. It has been a long, hard job to convince people that the forests were for use and even harder to get multiple use understood. While there was an abundance of timber outside the national forests to keep the lumber industry humming, few cared very much whether the national forests were preserves or managed or unmanaged. Indeed, during the depressed thirties, a policy of holding back national forest timber was adopted because it seemed to be in the public interest.

The timber outside the national forests is running low. More and more dependence will be placed upon national forest timber in the future. In a wood-hungry nation this can lead to pressure for overcutting and abandonment of sustained yield management. It may even lead to demands that national forest land be turned over to private owners. When there is not enough timber to go around, our management plans will be front page news in many communities. Up to now we have been permitted to make plans in the quiet of our ivory towers; tomorrow we may feel like we are making them on Main Street. Angry citizens may shake their fists in our faces and tell us that our allowable cut will take the food from their children. Making management plans when there is not enough wood to go around will be serious business. It will be a serious business on which people will need to be fully informed.

There is ample experience that more than technical soundness is essential to the success of a management plan. Our own experience in Region One with the plan for the Kootenai Sustained Yield Unit is an example. This plan has been the subject of a heated local controversy. The technical soundness of the plan has not been questioned. Its effect upon people and communities has been the main point at issue. The fact that we have distributed 2,000 copies of the proposed agreement and have in other ways tried to get the plan understood has, in our opinion, been the one thing that has enabled us thus far to weather and even perhaps to advance against the storm of criticism.

At this point it would be appropriate to change the topic heading to read: "How to Use Good Public Relations Tools in Preparing Management Plans." Several suggestions are submitted for discussion:

1. Write every management plan so it would not embarrass the Service if it were published in a newspaper in the working circle. This does not imply that every plan will be or should be published. It means that our plans are public property open to inspection just like other public business. Sooner or later they will be read to some extent by people outside the Service. Simplicity and understandability are prime requirements. Professional writing that makes prominent use of formulas, statistical lingo and technical words and phrases is offensive to the lay reader and is not a credit to the Service. God-like pronouncements of policies affecting the lives of people are also offensive.

2. Make the plan available to interested people. This may mean providing for the distribution of the plan itself or preparing an abridged or special edition for public consumption. It might be good business to include in every management plan a special statement for public distribution.

3. Use statements, phrases or words that will not offend the people affected by the management plan. Such terms as "submarginal land," "underprivileged people," "low standard of living," "selfish interest," etc., should be avoided. It is all right to present facts and figures objectively. Let them speak for themselves. Name calling is a poor technique that is not used in skillful public relations work. Try to put yourself in the place of the people affected by the plan. Write with sympathy and understanding. Be firm, if necessary, but do not run down the other fellow's motives, standard of living, or intelligence. Do not talk down or belittle. Remember that the people living under what appear to be adverse circumstances in our working circles often display an independence, an integrity, and a strength of character equal or surpassing that found in prosperous urban centers. Some of our best citizens live in the hills and valleys of our working circles.

4. Provide for discussion of the plan with local people. A management plan job is not complete until the plan has been made known to and discussed with the people affected. They may or they may not accept it and we in turn may or may not accept all their suggestions. Nevertheless, discussion with the people affected should become a regular part of the procedure of putting a plan to work. Critics can embarrass us no end if they can say with any justification whatsoever that we have not taken the people in the working circle into our confidence. Ivory tower plans will not stand up. If we can say that a plan has been discussed with a large number of the people affected and accepted by them we have one of the best answers to critics with an ax or two to grind.

5. Develop publicity that will dramatize management plans. Foresters really have an intensely interesting subject. We plan for the future in terms of decades; cutting cycles of 30, 40, 50 or 60 years; and rotations of a century or more. We are men of good will, today, tomorrow and for all time. Foresters are trained to skillfully plan for the future. Our profession is outstanding in this field. It is high time that we developed ways and means to make laymen see the future through our eyes and help us plan for it.

Someone with imagination and skill with words once described the activities of a community of ants and created a fine piece of literature. The work of the raindrop has been dramatized in a recent film. A storm is the center of

interest in a stimulating book. If ants, raindrops and storms can be dramatized and made real to us, a management plan is not without possibilities. Management plans affect the lives of people from the cradle to the grave. Therefore, they operate in the center of the stage with human actors living life itself. Foresters should be the first to dramatize the fact that there is more to a management plan than trees.

Someday the citizens of Rock Creek will sit comfortably in front of their television screens and review the management plan that the Forest Service is proposing for their working circle. There will be a pleasant voice to tell the story. There will be animated maps, charts and graphs to catch their eyes. There will be scenes taken on the ground to show the processes of management. There will be interviews with leading citizens and reports of discussion meetings. If, after 30 minutes or so of combined entertainment and education, the citizens feel that the Forest Service has demonstrated its integrity, that the plan is understood, and that they have had a part in its development, the plan will probably be a success.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
WASHINGTON

S
SUPERVISION
Meetings
(Management Plan Conference)

April 4, 1949

K
PERSONNEL
Training
(T.M. Conference - Hot Springs, Arkansas)

## TOPIC 26 - HOW TO TRAIN MANAGEMENT PLANNERS *

by

Warren T. Murphy
Inspector, Branch of A.M.&I.
Chief's Office

The scheduling of a discussion of the process of training timber management planners as the last item on your agenda before the consideration of committee reports places this important subject in a well timed place on the program. You are down to the point in your deliberations where, after a thorough examination of the subject, you are asking yourselves what should be done about it all in terms of converting your conclusions into action in the field. Adequate training of the personnel entrusted with the task of preparing timber resource management plans is certainly one of the essentials of an action program aimed at bringing about better management planning. All of you have borne witness over the years to the basic necessity for training personnel by the efforts that each of you have put forth to train men in your region and at your station in the techniques of better planning for the management of timber resources on the national forests.

To a very considerable extent the preparation of adequate management plans, where such have been prepared by field men, have reflected a good job of personnel training by forest supervisors and timber management men from the regional offices often ably assisted by members of the experiment station staffs.

I am certain that the individual experiences of each of/have been such that it is unnecessary to devote any time to a review of the reasons for training technical personnel. We do not question the necessity for training as an integral part of the job of any supervisor. This then brings us to the point of asking ourselves "How to train in such a manner as to get the greatest return for our investment of time and money?"

---

* To be presented at the Management Plan Conference, Hot Springs, Arkansas, March 28 - April 8, 1949

First, let me say, I do not have any pat formula or bag of tricks to unwrap at this conference that will give you an exact answer to this question. The best that I can do is to examine with you some of the principles, approaches, and guides that can aid you in arriving at the answer to the question in your particular case. Let us consider some of these aspects of the task of training foresters to do a better job in your field of work.

1. The Approach to Training

This is very important. It has to do with our attitudes toward training, the priority given to training as an essential part of the whole general field of supervision, and the recognition of the impact of the organizational structure on the training process.

a. Attitudes toward training.

The Forest Service philosophy, objectives and policy in regard to training of personnel is set forth in Section 85 of Chapter E of the of the Forest Service Manual (Vol. I) and in the booklet "Employee Training Program - With a Discussion of Policy and Method" by Peter Keplinger ,June 1940. I recommend your review of these writings before you embark upon any training activities. Of particular significance are Pp. 1-8 and 10-12 of the June, 1940 booklet.

I will not attempt to repeat all of the objectives and suggestions that are in these references. You will find them well worth study.

It is essential that the continuing nature of training be recognized. There is too often a tendency to set up a "training program" which is generally nothing else than a "one shot" effort. While such efforts do produce some results, often they are rather like a blanket or shot gun approach which does not get to the heart of individual cases and needs.

Closely akin to the "campaign" or sporadic "program" approach to training is the inclination of some folks to make "training" a "selling" job. The idea of "selling" something in the guise of training personnel, especially when it is announced that you are out to "sell" a procedure, a plan or a program builds up a resistance and throws training as a ligitimate and integral part of supervision into disrepute.

Absolute sincerity and personal belief on the part of trainers in the training process and in the subject matter being taught must characterize training efforts. If this attitude is not cultivated, the training effort will fall in prestige and be regarded as a time wasting frill.

If a certain course of training action is decided upon it should be carried through and not be the very first item lopped from the overall program when there is a chill in the financial wind. If curtailment of a planned training effort becomes necessary, give the project high priority when it becomes financially possible to resume full operations. If there is material doubt concerning the possibility of carrying through a course of action in training, it may be best to settle for a less expensive approach which can be carried out. All of our people are very busy and working under full work loads. They do not like to be called upon to participate in a program that has an air of "dispensability" about it.

b. Recognition of organizational structure in approaching the training task. Possibly I had better call this the "teamwork" approach.

By this I make reference to the absolute necessity of enlisting the full cooperation and active support of the field technician's immediate supervisor (usually the forest supervisor) in any training you may give to the technician who will prepare the resource management plan.

While the title of the topic I am discussing has to do with training management planners (who will often be forest staff men) I might add that it could very well be enlarged to include forest supervisors in its scope.

Those of you, who while in a regional office, are not division chiefs, must be especially alert to the impact of organizational arrangement and lines of authority upon the action you may take to accomplish the desired training. I emphasize this point because the reaction of an immediate line supervisor can have a very vital part in determining the success or failure of your training efforts.

Ideally the best approach to training is through the technician's immediate work supervisor. However, where the line supervisor is not in a position to give the type of training desired, it becomes necessary to devise substitute methods. Where the line supervisor is not aware of the new principles, philosophies, and techniques involved he may destroy your training efforts without consciously doing so. On-the-job training given by the work supervisor in his ordinary day-to-day working relationships with the technicians, whether the supervisor or technician is aware of it or not, is very persuasive. Get this day-to-day and on-the-job instruction to supplement, not obstruct, any specialized training you may give.

Therefore, I suggest that before any training of staff men takes place, you bring the supervisors in for some training or at least work with them on the ground in developing an understanding of what you are doing. It pays dividends in long term results. It will develop team work in resource planning. You, of course, will wish to study each training situation that you face and work out this particular phase to fit the needs of the situation.

c. Use of the Regional Training Officer.

Call this man into your deliberations early in the development of your training plans. He can be of considerable help to you in developing attitudes, training approaches and situation analyses.

2. Training Must be Carried on in Accordance with a Definite Plan if it is to be Successful.

This may seem to many of you to be an obvious fact. Nevertheless, it is an approach that is not universally observed. However, it is an approach that must be followed if we are going to get the greatest return from our training efforts. I am not advocating extensive and detailed written plans that constitute an undue burden of paper work, but rather concise plans that give assurance that the training process being applied has been logically and thoughtfully developed. There is nothing new about this process that I am describing, but I believe that it will be worth our while to consider the essential steps of such a plan.

a. Analysis of training needs.

This will involve analysis of your technicians as a group and as individuals. In the final step it is necessary to carry the analysis down to each individual who will be expected to prepare resource management plans.

Performance as indicated by inspection, plans that have been prepared and by your general knowledge of an individual's knowledge and background give you a starting point here. When analyzing the training needs of the individual, it is best to have him participate in the analysis.

b. Consider the training needs in relation to existing organization, job performance, personnel and related situations.

Identify pitfalls and special situations that may modify your conclusions and plans.

c. <u>Develop a training plan to meet the needs with due consideration for the axiom that "The situation dictates the decision".</u>

Be sure to:

(1) Give recognition to the essential four steps in a training process. You are familiar with these, I am sure.

<u>First:</u> Stimulate interest and cooperation of the trainee.

<u>Second:</u> Instruct by telling, demonstrating or illustrating the correct way.

<u>Third:</u> Trainee tries the job for himself with aid of the instructor.

<u>Fourth:</u> Test and check of trainee's ability to do job. Follow-up on training.

(See U.S.F.S. "Fire Guard Training Handbook" - Pp. 28.) Even though a conference or seminar approach is adopted as the training device with a merging of steps two and three, it is very important that the plan developed give full consideration to the points raised in the first and fourth steps with the second step incorporated in the conference outline.

(2) <u>Make Provision for the Development or Availability of Satisfactory Instructional Material.</u>

A clear cut understanding of what is to be taught is necessary. This may require the actual preparation of a manual in advance of any training process.

(3) Make a selection of training devices that are suitable to the situation that confronts you.

(4) Set up time objectives in the form of schedules for completion of training.

3. <u>Training Devices and Methods.</u>

In speaking of training plans, I mentioned the selection of training methods as a part of the plan. It is likely that more than one method will be used. The most important are briefly reviewed below:

a. Of greatest importance and most universal application is "on-the-job" training. Yet because of its universality, the most is not made of the possibilities of this means of training. A basic requirement here is the cooperation of the technician's supervisor, plus the availability of adequate and correct subject matter material for reference and guidance.

Many ordinary work situations can be converted into opportunities for training.

At this point current monthly work plans must be integrated with the training plan if "on-the-job" training plans are to be converted into action.

b. "Inspection" as practiced in the Forest Service is a useful training method. It ties in closely with "on-the-job" training. The method deserves wider use.

c. Group training. At the level of professional men to be reached in connection with management plan preparation training group training can usually best be handled in the form of conferences or seminars. A well prepared and competent conference leader is required to assure the success of this method. It is very desirable here to create a sense of genuine participation in the development of conclusions coming out of such conferences.

There are several variants of the group meeting technique ranging from the straight class room presentation to the conference - working committee approach. The technique used should be tailored to the group being reached.

d. Training details. This is a procedure used where rather individualized training is contemplated. We should not use a training detail primarily to find out what a man can do in a new job, but as an honest training device. The detail may be to another forest or to the regional office or the experiment station.

e. Special project assignment, or working clinics.

This involves bringing several trainees together on a work assignment under a competent leader. The group would have a job to do such as preparing a management plan for a specific area. It would be an actual job and not a theoretical situation.

f. Transfers to special work assignments.

g. Field demonstrations. This would involve group visits to national forests and experiment stations to see the developments and use of actual management plans.

h. Visual aids.

We are told by visual aid experts that a field of work such as management plan preparation is not well suited to the use of movies and film strips. Charts and "blow-ups" for use in conferences, lectures and demonstrations are about the extent of visual aids required here.

i. Supplementary reading. To the extent that there are suitable references available these should be circulated for use and study by the management planners.

j. Inter-forest visits and visits to experiment stations and areas on an individual basis.

k. Participation in professional meetings - professional writings.

4. Training Follow-up. This is often the weakest link in our training process but a vital step that must be observed. It is tied in with "inspection", stimulation of employees through various devices such as reports, short studies, details, refresher training and conferences.

5. Joint Regional and Experiment Station Training Efforts. I just desire to place added emphasis on the necessity for close collaboration by the members of the several forest experiment stations and of the regional offices in training efforts of the type under discussion. Much good joint training work has been done in the past. We anticipate more in the future.

You will probably realize as you read this paper and attempt to relate it to my discussion at the Hot Springs Conference that it is but the outline of my remarks there. I am certain that a full verbatim report would be unduly boring and lengthy. Also you will see that I have not attempted to treat with detail all of the intricacies of training technique. Rather, I have attempted to present the whole problem in its broader phases. The details and exact procedures that you should follow in your region or station can best be developed back home in consultation with your division chief and personnel training officer. Your training officer stands ready to assist you all that he can in meeting the specific training problems that you face. Do not hesitate to call upon him.

As one of the two non-timber management men on this program, I have appreciated the opportunity of meeting with you and discussing some of the phases of your problems. You have a challenging and yet rewarding task facing you in bringing about the development of more effective timber resource management plans. Well planned and executed personnel training can be a useful aid to you in meeting this challenge that lies ahead of you.

S
PLANS
Timber Management

Portland, Oregon

March 24, 1949

MANAGEMENT PLAN CONFERENCE - TOPIC 28

CRITICISM OF "TIMBER MANAGEMENT PLANS ON THE NATIONAL FORESTS"

## 1. INTRODUCTION

In the preparation of this paper the writer has attempted to incorporate the suggestions not only of his two assistants but of a number of other people who were good enough to review Mr. Gross's preliminary draft and to furnish their comments. It is realized that any criticism prepared in advance of this meeting will prove incomplete since much of the discussion prior to the time this paper is read will have a direct bearing on any revision of Mr. Gross's paper.

## 2. GENERAL COMMENTS

All probably will agree that in preparing "Timber Management Plans on the National Forests" Mr. Gross did an excellent job. However, the paper should be reviewed critically from the standpoint of its usefulness in management plan preparation. Obviously the first question to consider is: Does the paper in its present form fulfill its purpose? In other words, will it aid the management planner in the preparation of plans, and will it serve to speed up and improve our accomplishment in the management planning field? In general the answers to the above are yes, but there appears to be a rather widespread belief that in spite of its statements to the effect that management plans should be concise, the actual products which will be produced when it is used as a guide will prove to be extremely lengthy and involved. This feeling is partly due to the fact that all through the paper statements such as "the plan should include . . . . ," appear. In other words, there is likely to be some confusion as to whether the paper is merely a philosophical discussion of management plan preparation or whether it is, in fact, instructions which the planner should follow.

Another factor which will tend to continue to make plans lengthy and involved is the manual requirement that management plans be approved by the Chief's office. There seems to be rather general agreement that such approval is not only unnecessary but results in an extravagant waste of time and money. It has been pointed out that management plans are about the only form of plan which still must be approved by the Chief's office, and there is a general belief that much greater progress would be made in management planning if this requirement were removed, or at least modified. So long as plans must be submitted for review, they necessarily must contain much detailed information solely for the purpose of informing the reviewer and making it possible for him to intelligently judge the merits of the plan.

In line with the above, the following general recommendations seem in order: (1) That additional emphasis be placed on the fact that the paper or pamphlet is intended and is to be used as a guide only. This can be accomplished partly in the revision of the paper itself and partly by strong clear statements in the manual; (2) That this group strongly recommend a modification of the present requirement that all management plans be formally approved by the Chief's office.

Approval of a limited number of plans on a sampling basis might be a substitute for the present requirement.

3. <u>SPECIFIC COMMENTS</u>

In the following, in most instances, no effort is made to recommend specific revisions, but rather the purpose is to raise questions which may lead to a discussion and a final recommendation for change.

<u>Title Page</u>: Can the title be improved? For example, would it be more meaningful if the title read "Discussion of Timber Management Planning for the National Forests"? Actually the paper contains considerable discussion of the science of management. Is that proper?

<u>Table of Contents</u>: It has been suggested that organization of the material would be better if it followed the following broad outline:

A. Management Plan Outline

B. Management Plan Surveys

C. Management Plan Discussion

D. Regulation Formulas

E. References

Quite likely the present organization of material is satisfactory and to revise the paper in this respect would be an unwarranted task.

<u>Page 1, Line 1</u>: Comment has been made that describing local conditions serves no real purpose of the management plan and is only necessary for the benefit of a reviewer. If future policy does not require approval of all plans by the Chief's office, regional instructions can limit such descriptions to a minimum.

<u>Page 1, Lines 4 to 6</u>: If this definition of a management plan is followed literally, the plan must necessarily be extremely long and complete. In actual practice in National Forest administration most of the policies and practices followed in the growing, improving, harvesting, and reproducing of timber stands are covered completely by manual and Timber Management Handbook instructions. To repeat all such material in individual plans seems entirely unnecessary and would result in endless duplication. It is suggested that this sentence be changed to read somewhat as follows: "A National Forest management plan is an action program for putting approved forest and regional management practices into effect on a particular working circle."

<u>Page 1, Line 8:</u> It is suggested that the word "instructions" might be misleading. This sentence might better read: "This discussion has been prepared . . . . . ."

<u>Page 1, Lines 9 and 10</u>: In line with the discussion under "General Comments", the following might be added to this sentence: "and the planner should bear in mind that regional instructions are his guide as to content of the plan."

<u>Page 1, Rest of Page</u>: It is a rather unanimous opinion of all who have reviewed the paper that the summary and the final paragraph on this page should be deleted.

Page 3, Paragraph Numbered 4: Throughout the paper the objective of stability of community and of employment seems to have been emphasized to the partial exclusion of other objectives. It is suggested that the phrase at the end of the sentence reading "of stability of the community and of employment" be changed to read "of management".

Page 3: It has been suggested that the minimum requirements as listed on this page should be expanded to include (1) specific provision for future revision of the plan, including such record keeping as is necessary, and (2) provision for correlation of timber management planning with other land uses. Both of these matters are important.

Page 5: The definition as given for a working circle probably should be revised. The guiding principle in the definition as written seems to be that the working circle must contribute to the support of a dependent community or communities. This is certainly true for Coop. Unit Working Circles, but entirely too much emphasis appears to have been given to this factor, and it is suggested that all of line 12 be omitted. A new sentence could be inserted as the second sentence of the paragraph, somewhat as follows: "It should be a logical unit subject to practicable and efficient management and administration."

Page 5, Last Paragraph: The last half of the last sentence is questionable and is suggested for deletion or change. Many communities benefited by National Forest working circles are not dependent thereon; therefore, practicable management rather than community dependency should be the paramount consideration in determining the size of working circles.

Page 6: All of this page should be considered for possible revision in line with the thought expressed above. The last paragraph on this page seems to be particularly inappropriate.

Page 9: There appears to be a widespread feeling that the compartment is not a useful working circle subdivision and that its use should be abandoned. If working circles are properly laid out further subdivision, especially for inventory purposes, seems unnecessary and merely leads to a great deal of additional work. It is recommended that the compartment idea be largely abandoned and that subdivisions of working circles be made only when they serve some definite and useful purpose.

Page 11: Considerable confusion appears to exist as to the intent of the write-up under "Timber, by Ownerships". A literal interpretation would indicate that both the map and statistical records should show all the data listed. Obviously, maps would not need to show species and volumes. Some reviewers have gained the impression that types, sites, etc., should be shown for private as well as National Forest land. This probably was not intended but needs clarification. Question also has been raised as to why private lands should be shown by large and small ownerships. Ownerships change rapidly, and this perhaps is an unnecessary detail in many management plans. If the outline is not changed, the write-up perhaps should make it clear that there is considerable latitude for its use and that information included in the plan should be restricted to that which is actually pertinent or useful. Information concerning private ownerships, except in cases where cooperative sustained yield is involved, usually can be given in very general terms.

Page 12, First Paragraph: Question has been raised as to why maps should show topography. Generally topographic maps are not available; therefore, this statement perhaps should be qualified. Question has also been raised as to the use of overlays. Generally, overlays are unsatisfactory.

Page 13, Second Paragraph: Several questions have been raised concerning the statements in this paragraph. The second sentence seems to infer that for uneven-aged management no age class segregation is necessary. One reviewer points out that there is a need to segregate virgin stands from cut stands. Another reviewer has questioned the use of twenty years as the interval for classification of even-aged stands, and another points out that in some situations size classes may prove a better basis for information than age, in which case size class maps would be used. Some change in this paragraph undoubtedly is desirable.

Page 13, Last Paragraph: Question has been raised as to whether or not this paragraph, as well as all of the next page and all of the "Socio - Economic" discussion, should not be deleted. The danger here appears to be that a management planner in preparing otherwise simple plans might devote considerable time to a discussion of these topics and that such discussions would serve no purpose except to clutter up the plan and make it less usable. The subject in the last paragraph on page 15 perhaps should be expanded or emphasized.

Page 17, Second Paragraph: Rotation is mentioned here as applying in all cases, whereas later in the text (page 28) it is pointed out that rotation is meaningless for uneven-aged management. Perhaps the words "or an equivalent period" should be added to the second sentence.

Page 18, First Full Paragraph: All forest officers will not agree entirely with this statement. To a degree, and in special circumstances, management plans can be useful tools in the field of public relations. However, if all management plans are written with this in mind and a conscientious effort made, an extra and unnecessary complication will be introduced. However, all plans are subject to public inspection and should be prepared with this in mind.

Page 18, Forest Types: The discussion here might lead many management planners to attempt intricate breakdowns into types. This, of course, can be controlled by good regional instructions, but perhaps a word of caution should be included to the effect that only useful type breakdowns should be made.

Pages 19 and 20: Material on these pages calls for the inclusion in the management plan of a discussion of many things that could well be covered by regional or forest instructions. For example, silvical characteristics could be covered merely by reference. Likewise, methods of cutting can be handled largely by reference and need not be covered or discussed in detail in an individual plan. Inclusion of graphs, such as are suggested in the sentence beginning with line 10, hardly seems necessary. Such things as these could well be a part of regional handbooks and inclusion as a part of the management plan merely complicates and delays the plan's preparation. Logging methods also would seem to need little discussion in the management plan and generally should be covered by regional or forest instructions as to policy and practice. Somehow in the revision of these two pages a statement should be included cautioning the planner against including the type of material that is already adequately covered by regional instructions.

Pages 21, 22 and 23: The topics under "Transportation" and "Utilization Roads" are important and in many working circles will exercise much control over the size and boundaries of the unit. Here, again, however, our management plans are apt to be unnecessarily involved in lengthy discussions, and the planner should be cautioned against including anything but very pertinent material, and then only when it is not covered by a separate transportation plan. The first full paragraph on page 23 appears to be involved with what is ordinarily considered policy, and this paragraph perhaps should be deleted.

Pages 24, 25 and 26: It is difficult to criticize the write-ups under "The Community", "Industries", "Markets", and "Marketing Assistance" on these pages. The discussions are good, but there is always the danger that management planners will fill their plans with discussions of topics such as these and thus defeat our avowed purpose of keeping management plans simple and to the point. Discussion of community support in any publication is good public relations; however, many of our working circles will be managed purely from the standpoint of greatest general good or benefit with no specific community in mind. Perhaps the emphasis should be placed on "community benefits" instead of "community dependence". In the discussion of "Markets" and "Marketing Assistance" it might be well to make clear that the discussion largely has to do with management of the resource rather than with management plan preparation and that ordinarily it will not be necessary to include much discussion in a management plan on these subjects.

Page 27, Even-aged Management: In the discussion of this subject it might be well to point out that rotation age is an average figure adopted to facilitate management planning. In most working circles, especially in the West, there is a wide variation in site quality; therefore, the actual rotation age may vary as much as twenty or thirty years for particular stands in the working circle.

Page 29: Region 8 has the following to say with reference to Publication 50:

> "The stands in this publication were never subjected to management prior to being measured. They are over-crowded — subject to heavy mortality and greatly reduced growth on individual trees. We should never let our stands reach the condition of the stands outlined in this publication. The choice of whether to cut or leave a tree should be based on whether that tree is capable of earning a fair return on its present volume, both in quantity and quality. Adherence to a fixed rotation age will often result in cutting trees that are still capable of growing wood at a good rate. Rather than trying to fix a rotation age, it would be better to designate in the cutting budget stands for harvest cutting when such stands have reached maturity and good silviculture and economics dictate such a cutting. A long-time forecast based on unmanaged stands can be of little help."

Here again there is chance for confusion, especially if regional instructions are not carefully drawn. In actual practice management planners for National Forest working circles should be guided by regional instructions rather than by the paper under discussion.

Page 35: The first paragraph on this page seems to merit discussion and perhaps clarification.

Page 37, Growing Stock: This is a complicated subject and no doubt could be expanded considerably. Region 8 comments as follows:

> "Determination of amount of growing stock in the early stages of managing timber is useless. It can often be misleading. We have no way of knowing how fast the timber can be made to grow under management. There are cases where 20,000 ft. per acre were only growing 3% or 300 bd. ft. per acre per year.

After the stand was reduced to 10,000 bd. ft., the rate of growth was increased to 6%, or still 300 bd. ft. per acre per year. An arbitrary volume of growing stock based on unmanaged stands is dangerous and may cause us to hold more than the health and the vigor of species can withstand."

Page 45: The whole subject of "Methods of Regulation" is necessarily complicated and probably, regardless of how complete the discussion, there would always be questions raised as to application of the various methods to particular situations. This topic deserves special consideration, and it is hoped that discussion at this meeting will indicate what revisions, if any, are desirable.

Page 55, Cutting Budget: The need for both a detailed cutting budget and a harvesting plan is questionable. Duplication, of course, should be avoided, and if a harvesting plan is prepared for a two or three-year period, the cutting budget probably should include nothing more than a general statement of planned cutting.

Page 56: The last two sentences on this page appear to be matters of policy. The next to last sentence might be changed to read, "Regional Foresters ordinarily will issue appropriate instructions, etc.," and the last sentence could well be deleted.

Page 57: The term "unallocated" in the first sentence on this page seems to need defining. Also, the discussion under "Size of Sales" deserves some further consideration. It seems questionable, for example, that a paper on management planning should express a preference for any particular size of sale. The statement "Short-term sales generally are preferred" is an example.

Page 60: The next to last paragraph under "Timber Stand Improvement" seems to need some clarification. If the words "timber sales" were deleted and "sale of products (example, intermediate cuttings)" added, the intended meaning might be more clear. The next paragraph states that a program of timber stand improvement should be included in the management plan. Generally, it seems that actual programs should be separate from the management plan and that the plan should include only a general statement of policy and needs.

Page 61: Under the topics of "Acquisition" and "Related Uses" it is important that the planner understand that these topics can be handled largely by reference to existing plans. Unless this is understood a lot of duplication is apt to result.

Page 62: The second paragraph on this page is largely a duplication of the second paragraph on page 39. The last paragraph on this page is questionable as a part of a discussion of management planning.

Page 64: The words "allocated" and "unallocated" appearing in the next to last paragraph may need defining.

Page 66: Much discussion probably will be had concerning the best type of management plan outline. Much depends, of course, on for whose use the outline is prepared and how it is to be used. The outline as given is not intended for blind following, yet the opening paragraph contains a statement to the effect that all points of the outline should be included. This statement should be modified to make it clear that all points in the outline need not be included in every case, especially when they are adequately covered by separate plans or instructions. It is difficult, of course, to prepare an outline which is comprehensive and yet does not cover a lot of detail that is not necessarily a part of every plan. If the management planner has the job of preparing a plan for a forest in private ownership, for example, he would need to cover many of the topics of the outline in much greater detail than is necessary for the ordinary National Forest working circle. For National Forests much of the plan for management has already been determined and is adequately covered by such things as manual insert sheets, regional management handbooks, inventory and cutting records and separate plans covering such things as transportation, planting, timber stand improvement, acquisition, etc. Actually on an active working circle a pretty good plan of management is in effect, if all of the above is available, properly organized for use, and kept current. About all that is needed in addition is a determination of allowable cut and a cutting budget or harvesting plan. Just how much detail needs to be put in the so-called management plan depends, of course, on local situations, but in every case duplication should be avoided.

Topic Assignees - Lund
(Bryan)
(Lindh)