FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: Utilization of Reeds in Forest Grazing. P14-ai3 (Purnell) Subproject 12.

2. Departments and cooperating agencies: Animal Industry, U.S.D.A., U. S. Forest Service, N. C. Department of Agriculture.

3. Major personnel: W. O. Shepherd, R. H. Hughes, E. U. Dillard and J. L. Rea, Jr.

4. Date begun: 1948 Date revised/~~completed~~: 1951
If discontinued without completion state reasons: Work transferred to new project to be entitled "Forage Management in the Cane Type Forest Range."

5. Estimated total cost by funds (salaries and maintenance):

6. The problem (briefly restate its nature, importance, and economic significance):

To determine (1) forage productivity (in cow days of grazing) and forage quality (as indicated by chemical analysis) at five different seasons in relation to density and height of cane; (2) response of switch cane to heavy utilization at these five seasons as reflected in cane vigor and forage production during successive years; (3) the effect that tree cover may have on (1) and (2)

To date no evaluation factors have been devised for determining grazing capacity of cane with any precision. Efficient management of native range involves determination of available forages and then the application of grazing systems which will most nearly produce the results desired. In an area containing several million acres of this native forage proper management should be of great economic value.

7. Major results and conclusions:

Roughly foliage density in percent equals gross grazing capacity in cow days per acre from May to October. A factor composed of estimated foliage density and cane height gives a slightly better prediction of grazing capacity than does density alone or number of stems per square yard or height. During early winter grazing capacity drops about one-half. From February until active foliage production begins, cane growing in the open has little grazing value and under tree canopy its grazing capacity drops to one-third or one-fourth its summer capacity.

(over)

*Three copies to be sent to the Office of Experiment Stations.

8. Practical applications and public benefits achieved or in prospect:

9. Publications:

Director

FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: Utilization of Reeds in Forest Grazing. P14-ai3 (Purnell), Subproject 11.

2. Departments and cooperating agencies: Animal Industry, U.S.D.A., U. S. Forest Service, N. C. Department of Agriculture.

3. Major personnel: W. O. Shepherd, R. H. Hughes, E. U. Dillard and J. L. Rea, Jr.

4. Date begun: 1948 Date revised/~~completed~~: 1951
If discontinued without completion state reasons: Work transferred to new project to be entitled "Integration of Grazing and Forest Management."

5. Estimated total cost by funds (salaries and maintenance):

6. The problem (briefly restate its nature, importance, and economic significance):

~~See Working Plans for 1948 Studies~~

To investigate (1) techniques for the construction and establishment of pasture strip and firebreaks and (2) forage species adapted to Coastal Plain sites and suitable for use on firebreaks.

Wild fire is a major hazard of the forest industry in much of the Coastal Plain of North Carolina. Fire control in the area is difficult. There are good indications that grazing if applied specifically for fire protection would be a valuable control tool. Pasture sod would also supplement native forage as cattle feed.

7. Major results and conclusions:

Two grasses, redtop and tall fescue have been outstanding in maintaining a dense sod under grazing and in resisting weed invasions. Of the legumes, ladino and white Dutch clover have performed best thus far. Legume gave better fire protestion than grasses, but a mixture of a grass with a legume was better than either one alone. From the standpoint of inflammability in one test there was no significant difference between the flat lanes and those crowned and ditched. The crowned and ditched lanes would be much more valuable as access roads.

(over)

*Three copies to be sent to the Office of Experiment Stations.

8. **Practical applications and public benefits achieved or in prospect:**

9. **Publications:**

Director

Projects in progress at the Frying Pan Experimental Range, Tyrrell County, North Carolina

Utilization of Reeds in Forest Grazing - Purnell (P14-Ai3)
Range Study No. 13 - Management of Switch Cane Type Forest Range: Deferred Rotation vs. Continuous Grazing.

This study to develop and evaluate methods of managing forest range and livestock for sustaining a profitable range cattle enterprise was initiated in January 1950. Twelve ranges varying in size from 60 to 100 acres are devoted to the study.

The calf crop was less than 50% which was due in part to wet conditions last year it is believed. Differences between the management systems are not expected to develop until next year. In the past, about two years have been required for misuse of cane range to be reflected in cattle performance. (See Next page for current performance)

Range Study No. 14 - Cattle Management on Swtich Cane Ranges: Supplemental Feeding of Calves and Yearlings.

This study was initiated with two groups of yearling heifers in May 1950. One group was fed a protein supplement, the other was not. The supplemented group did better on range but both groups failed to perform satisfactorily in comparison to results expected from wintering at a farm. Last winter was rather severe, and additional trials are considered necessary to fully evaluate the possibilities of wintering on the range.

No yearling heifers are available for work in 1951 but weaned calves will be used in the winter of 1951.

Project: Development of Beef Cattle Especially adapted to the Coastal Plain Region of North Carolina and Similar Areas
S46-Ai17 R.M. S-10

Inter se matings were made within Brahman-Hereford and Africander-Hereford crossbred groups. The production of Romo-Sinuano-Hereford calves has been initiated. Comparison of performance between these three crosses and grade Herefords is being done.

The cows were maintained in reasonably good condition over the winter by supplementing the range with soybean oil meal - 3 to 4 pounds per head daily from January through March, and 5 pounds daily in April. Cows almost maintained their weight from late December to mid-February, losing an average of only 7 pounds per head. From mid-February through April, weights declined an average of 70 pounds per head, primarily as a result of weight losses associated with calving. During May and June, daily gains have averaged 1.1 pounds for cows and 1.2 pounds for calves. Brahman-Hereford crossbreds have made appreciably greater gains this spring than have other breeds in the study, both cows and calves gaining about 1½ pounds per day.

In past studies the Brahman-Hereford crossbreds have shown slightly superior performance in the feed lot.

Projects in Progress at the Tidewater Experiment Station,
Plymouth, N. C.

Utilization of Reeds in Forest Grazing, Purnell (P14-Ai3)
Subproject No. 11 - Forage Species and Construction
Methods Useful for Establishing Pasture Firebreaks
in The Pond Pine Forest Type.

In moderately brushy land, a bush-and-bog harrow or a Marden rotary brush cutter, were found to be about equally effective for the initial construction of pasture firebreaks. A Mathis fire-plow followed by the bush-and-bog harrow was particularly effective where brush was very large and thick. For most efficiency, it is thought that the plowing should be done several months in advance of the harrowing and seedbed preparation. Ditching and slight crowning of the lanes (with fireplow and road grader) proved to be highly desirable in poorly drained sites.

The main problem in maintaining effective firebreaks of this kind has proved to be the maintenance of a dense enough stand of palatable forage to resist the invasion of weeds - primarily rushes and sedges. For this purpose, local drainage, adequate fertilization, and selection of adapted species seem essential. Mowing is being tried as a weed-control measure, but it appears that renovation may be necessary to restore the effectiveness of firebreaks which have been invaded by sedges and rushes.

Among the legumes, Ladino and white Dutch clover, and big trefoil have given best results, and indications are that a legume should always be included in the mixture planted. Of the grasses tried, tall fescue, redtop, and Dallisgrass are promising, although Dallisgrass was slow to establish. Redtop was particularly effective in controlling weeds but tended to be somewhat inflammable.

Inflammability was tested with fire during a period of very high fire hazard in 1950. In general the lanes were effective fire barriers. Legumes were less inflammable than grasses, and a mixture of a grass with a legume was best. The use

of pasture firebreaks is showing much promise, both as a ~~service~~ source of supplemental forage and as an aid in fire control.

Subproject No. 12 - Grazing Capacity and Response of Switch Cane to Utilization at Different Seasons.

This study is showing that cane is particularly susceptible to overgrazing in the spring and summer, relatively resistant in the fall, and undamaged by winter grazing. Under trees, grazing capacity remains relatively constant from May through October, drops about one-third during early winter (Nov. - Jan.), and one-half to two-thirds during late winter (Feb. - Apr.). In the open, cane sheds most of its foliage in winter and is not grazable after January.

Except in spring, the protein content of cane forage under trees has been found to be higher than that of open-grown cane. No effect of the tree canopy on the calcium or phosphorus content has been found.

It has been found that grazing capacity can be predicted with reasonable accuracy from estimates of the percentage of foliage ground cover and cane height, or the number of stems per square yard and cane height. As applied by one investigator, such estimates were within 15% of the grazing capacity measured with cattle. A test ~~of~~ of the methods was run in July 1951, with seven investigators, but the results have not yet been analyzed.

Project - Evaluation of Permanent Pasture Species.

Yearlings and 2-year olds, Grade Herefords, were pastured on the 12 paddocks of 2 acres each of various combinations of grasses and legumes. The pastures were seeded in 1948. The legumes used were big trefoil, Ladino clover and white Dutch clover. The legumes were each seeded with various grass combinations. The data has not yet been analyzed, but no appreciable differences between pasture mixtures are showing up in cattle gains this year. Cattle performance on all the pastures has been favorable.

Should have included funds from P47-A10 be diverted also. Prof. Hostetler called this to Dr. Cummings attention.

H.O.
4-17-51

14 April 1951

Dr. R. W. Cummings
Director of Research
N. C. Agricultural Experiment Station
Campus

Dear Dr. Cummings:

The purpose of this letter is to outline the status of Project P14-Ai3 entitled "Utilization of Reeds in Forest Grazing" and its several subprojects.

Final reports for Subprojects 1, 2, and 3 were submitted in 1949, and final report for Subproject 6 was submitted in 1950. You will find enclosed with the Experiment Station reports completed reports for the Master Project and for Subprojects 4, 5, 7, 8, 9 and 10.

Two other subprojects, numbers 11 and 12, are being revised and revision forms are submitted with the Experiment Station reports. It is proposed that the work formerly conducted under these subprojects be transferred to new State projects. Five copies each of the following proposed new projects are attached.

1. Integration of Grazing and Forest Management. (This is revised to include the work formerly carried under Subproject 11.)
2. Forage Management in the Cane Type Forest Range. (This revision includes the work formerly conducted under Subproject 12.)
3. Cattle Management in the Cane Type Forest Range.

Most of the major facilities such as land, cattle and fences have been provided, and it is believed that the three new projects as outlined above can be operated by the use of some State funds along with support provided by the Bureau of Animal Industry as a cooperating agency.

It is further recommended that the Purnell funds which have been used in the support of the P14-Ai3 project be diverted to the support of two projects which are now being prepared dealing with the utilization of improved pastures by beef cattle and swine. An outline of the proposed work under these projects is attached and formal projects will be submitted at an early date.

You will also find attached copies of Subproject 7. The Federal Inspector advised us that he was unable to find his copy of this outline, and these are included to complete the record.

If there is further information needed with regard to these projects we shall be very pleased to provide it.

Sincerely yours,

D. W. Colvard, Head
Department of Animal Industry

DWC:ho
cc: E. H. Hostetler

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1950
(Three copies to be given to the OES examiner)

a9 P14-ai 3

1. PROJECT: (Fund, number, and title): PURNELL ~~Agron. (7)~~ P14-12, UTILIZATION OF REEDS IN FOREST GRAZING.--12, GRAZING CAPACITY OF SWITCH CANE BY SEASONS IN RELATION TO DENSITY AND HEIGHT OF CANE AND TREE COVER AND RESPONSE OF SWITCH CANE TO UTILIZATION AT DIFFERENT SEASONS.

2. DEPARTMENTS AND COOPERATING AGENCIES:
Animal Industry, B.A.I., U.S. Forest Service, N.C. Department of Agriculture.

3. PERSONNEL: W. O. Shepherd, E. U. Dillard, R. H. Hughes, and J. L. Rea, Jr.

4. NATURE OF WORK AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked):

At the Tidewater Experiment Station an investigation is underway to develop a precise method for predicting the carrying capacity of cane ranges at different seasons of the year using an index composed of such factors as cane height, density of foliage canopy, and stem count. Carrying capacity is expressed in terms of cow days grazing with gains being used for additional information. Forage samples collected during the year are being chemically analyzed. One year of grazing has been completed and the second year will be completed early in 1950. A preliminary survey of data is indicating that carrying capacity can be calculated with reasonable accuracy from the factors mentioned above.

File with 9 and 10

5. BENEFITS realized by farmers or the public through application of findings, stated in dollars, bushels, or other values, where possible:

The development of a reliable method for determining the grazing capacity of previously ungrazed cane ranges will provide a sound basis for utilization and conservation of the available forage. A reliable appraisal of the ranges prior to initiation of a grazing program will prevent much loss of livestock and destruction of the forage resources through overuse.

6. WORK PLANNED FOR NEXT YEAR:
This study will be continued in 1950. Information collected to date will be analyzed.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

8. APPROVED: ______________________ ______________________
Project Leader. Director.

6 July 1950

MEMORANDUM TO PROFESSOR E. H. HOSTETLER:

Subject: Revision of Forest Grazing project entitled "Utilization of Reeds in Forest Grazing". Purnell, P14-ai3

I have discussed with Mr. Shepherd, Mr. Goode and Dr. Stewart the comments by Mr. Nestler and others relative to revision of the above project. There seems to be some difference of opinion as to just what attack would be best for clarifying the work being done in connection with this project.

In line with what I believe to be the objects of this revision I would like to propose the following solution for consideration and approval by Mr. Nestler:

1. Records in this office indicate that with the final report presented this year for Subproject No. 6 all subprojects up to No. 9 have been closed or revised.

2. A revision report will be prepared for the major project which will indicate work completed to date.

3. In line with request by Mr. Nestler three (3) new line projects will be prepared for approval.

4. Current studies (Nos. 9, 10, 11, 12) and proposed studies (Nos. 13 and 14) will be classified under the appropriate line project. The present numbers will be maintained to prevent confusion by changing numbers.

5. It is proposed that the objectives for the three major projects will be broad enough to include present and proposed studies.

6. Any additional studies will be numbered consecutively beginning where present numbers stop and will be classified under one of the three line projects.

7. Proposed line projects will be:

   (1) Forage management in the cane type Forest Range. #12

   (2) Cattle management on cane type Forest ranges.

   (3) Integration of Grazing and Forest Management. #11

E. U. Dillard

E. U. Dillard
Assistant Professor
Animal Industry

FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: Utilization of Reeds in Forest Grazing, P 14-a13 (Purnell) Subproject No. 4.

2. Departments and cooperating agencies: Animal Industry, U.S.D.A., U. S. Forest Service.

3. Major personnel: J. E. Foster, W. J. Peterson, G. Matrone, H. H. Biswell, E. H. Hostetler and R. U. Dillard

4. Date begun: 1942 Date ~~revised~~/completed: 1951

If discontinued without completion state reasons: Discontinued in 1948 for lack of facilities, and adequate field supervision to carry out a well controlled experiment such as is necessary for a study of this nature.

5. Estimated total cost by funds (salaries and maintenance): $4000.00

6. The problem (briefly restate its nature, importance, and economic significance):

That the native forage is deficient in calcium and phosphorus has been established. There is also a possibility that certain minor elements are also deficient in forages of the North Carolina Coastal Plain. Calf crops have been found to be low in certain areas where cattle are grazed almost all year on native forages. The purpose of this study was to determine the effects of the absence of different minerals in a mixture on growth and reproduction.

7. Major results and conclusions:

No conclusive results were obtained from this study. The supplemental feeds used were found to contain small amounts of the mineral elements under study. The small amounts present in the supplemental feeds along with that in the forage was probably enough to provide the minimum requirements for the cattle.

(over)

*Three copies to be sent to the Office of Experiment Stations.

8. Practical applications and public benefits achieved or in prospect:

Results of this study were negative in showing a mineral deficiency, however, it is important to note that cattle with adequate native forage when supplemented with a protein concentrate meal and calcium and phosphorus during the winter months made good gains, maintained themselves in good condition and produced a satisfactory calf crop.

9. Publications: None.

Director

Great American
Insurance Company
New York
INCORPORATED-1872

Work done at
Heffman forest
thought there was a
cobalt deficiency

Ellis of Bell
insisted that work
be done - other
work seemed more
important so cobalt
was added to min mixture

FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: **Utilization of Reeds in Forest Grazing P14-s13 (Purnell) Subproject 5.**

2. Departments and cooperating agencies: **Animal Industry, U.S.D.A., U. S. Forest Service.**

3. Major personnel: **J. E. Foster, H. H. Biswell, E. U. Dillard, W. O. Shepherd and E. H. Hostetler**

4. Date begun: **1941** Date ~~revised~~/completed: **1951**
If discontinued without completion state reasons:

5. Estimated total cost by funds (salaries and maintenance): **$24,000.00**

6. The problem (briefly restate its nature, importance, and economic significance):

The primary purpose of this study was to study the effects of wintering cows on native forest range when they were fed different levels of protein supplement. Criteria used in evaluating results were winter and summer gains of cows and calves, death losses and percentage calf crops. In most cases the number of cattle that can be kept by a producer is determined by his winter feed supply. If by using a small amount of protein concentrate the number of cattle kept can be increased on a profitable basis the income from cattle for a large area of the North Carolina Coastal Plain can be materially increased.

7. Major results and conclusions:

Results indicated that as much as six pounds of protein concentrate per head per day could be fed economically. Indications from this study were that instead of feeding at a constant rate throughout the winter it would probably be best to start at about two pounds of supplement per day and increase it as the availability of the forage and condition of the cows dictated. Cattle receiving the least supplement lost more in the winter but they also gained more in the summer so that fall weights were again about the same. The feeding of only two pounds of supplement gave poorer results than either the 4 or 6 pound levels, but differences between those two rates were negligible.

(over)

*Three copies to be sent to the Office of Experiment Stations.

8. Practical applications and public benefits achieved or in prospect:

On good cane ranges protein concentrate will materially affect the condition of the cows in the winter months. The cost of such supplement makes it an economic practice. The amount of supplement and system of feeding will depend upon the amount and quality of forage available. The adoption of a supplemental feeding program with winter native range grazing should offer possibilities for greatly expanded beef production in the Coastal Plain of North Carolina.

9. Publications:

"Comparison of Different Amounts of Protein Supplement for Wintering Beef Cows on Forest Range in the Southeastern Coastal Plain." Journal of Animal Science, Vol. 4, No. 4, pp. 387-394. 1945.

_____

Director

Great American
Insurance Company
New York
INCORPORATED-1872

Some additional
data are available -
will be published
as soon as Dillard
and a graduate
student can do work

FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: Utilization of Reeds in Forest Grazing P14-ai3. Purnell (Subproject 7)

2. Departments and cooperating agencies: Animal Industry, U.S.D.A., U. S. Forest Service, N. C. Department of Agriculture.

3. Major personnel: J. E. Foster, H. H. Biswell, W. C. Shepherd, and E. H. Hostetler.

4. Date begun: 1940 Date ~~revised~~/completed: 1951
If discontinued without completion state reasons:

5. Estimated total cost by funds (salaries and maintenance): $8500.00

6. The problem (briefly restate its nature, importance, and economic significance):

To study utilization, palatability and value of native forage plants for grazing. This study was important to determine what native forage plants were available and their economic value as a cattle feed. It was also important to know the growth habits, chemical composition and other factors regarding utilization.

7. Major results and conclusions:

The major forage plants were classified as to type, seasons of availability, relative abundance, palatability and nutritive value. It was found that the thousands of acres of forest land in eastern North Caolina contain a large variety of palatable and nutritious forage species. Certain of these species exist in quantities large enough to give them economic worth as a source of feed for cattle under proper management.

(over)

*Three copies to be sent to the Office of Experiment Stations.

8. Practical applications and public benefits achieved or in prospect:

As a result of this study it will be possible for land owners, cattlemen and others interested to more accurately appraise their cattle feed resources. This will in turn bring about a more efficient utilization of those resources.

9. Publications:

(1) Stock-Poisoning Plants of North Carolina. N. C. Agr. Expt. Sta. Bulletin 342 (Revised) 1943.

(2) Native Forage Plants; Species Utilized by Beef Cattle on Forest Range in the North Carolina Coastal Plain. N. C. Agr. Expt. Sta. Bulletin No. 353. 1945.

(3) Digestibility of Reeds by Beef Cattle. N. C. State College of Agr. and Eng. Thesis, 1945.

Director

Great American
Insurance Company
New York
INCORPORATED-1872

Some further analyses, as reports from Sam, will provide basis for additional publications when Shepherd + Ellis can work together

FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: Utilization of Reeds in Forest Grazing, P14-ai3 (Purnell) Subproject 9.

2. Departments and cooperating agencies: Animal Industry, U.S.D.A., U. S. Forest Service, N. C. Department of Agriculture.

3. Major personnel: W. O. Shepherd, E. U. Dillard and R. H. Hughes

4. Date begun: 1946 Date ~~revised~~/completed: 1951
If discontinued without completion state reasons:

5. Estimated total cost by funds (salaries and maintenance): $6500.00

6. The problem (briefly restate its nature, importance, and economic significance):

The purpose of the study was to investigate the response of switch cane to definite degrees of defoliation at different seasons. Very little is known with respect to the degree of defoliation that switch cane can be subjected to and still maintain the stand and vigor. Any information of this type will aid materially in establishing a grazing program for maximum sustained productivity. Since the cane type amounts to many thousands of acres of valuable forage sound management programs are important.

7. Major results and conclusions:

The field work on this study has been completed, but analysis of samples and analysis of data are only partially completed in Nutrition Laboratories of B.A.I.

Observations thus far indicate that most of the season's forage growth has been made by July and regrowth after that is slight and leaves are small. Early complete defoliation (May) resulted in prompt regrowth with little apparent damage to vigor, whereas total defoliation in September killed about 10 percent of the cane stalks and decreased succeeding forage yields. Winter defoliation by hand seemed to have no effect on either stand or vigor.

(over)

*Three copies to be sent to the Office of Experiment Stations.

8. Practical applications and public benefits achieved or in prospect:

While hand defoliation might be expected to give somewhat different results from grazing it seems the major effects should be in the same direction. A knowledge of the growth habits of switch cane will enable the cattle producer utilizing this native forage to utilize the forage most economically. Proper utilization will be essential for conservation of this important native forage.

9. Publications: None

Director

Great American
Insurance Company
New York
INCORPORATED-1872

Shepherd is
writing thesis on
subprojects 9 + 10

FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: Utilization of Reeds in Forest Grazing. P14-a13 (Purnell) Subproject 10

2. Departments and cooperating agencies: Animal Industry, U.S.D.A., U. S. Forest Service, N. C. Department of Agriculture.

3. Major personnel: W. O. Shepherd, R. H. Hughes, E. U. Dillard and E. H. Hostetler

4. Date begun: 1946 Date ~~revised~~/completed: 1951
If discontinued without completion state reasons:

5. Estimated total cost by funds (salaries and maintenance): $4500.00

6. The problem (briefly restate its nature, importance, and economic significance):

The object of this study was to determine the seasonal fluctuations of food reserves of switch cane in relation to recognizable growth stages. Although switch cane possesses the facilities for rather high food storage capacity it, like any other perennial plant, must be allowed to build up food reserves between harvestings for sustained forage production. The knowledge of food resources and periods of depletion and reserve would contribute to a better understanding of proper management of this forage type.

7. Major results and conclusions:

Samples of the food storage organs (stems and rhizomes) were collected monthly for physiological study. Seasonal variations in "total available carbohydrates" ranging from 9 percent in June to 26 percent in October were found to exist. Apparently heavy drain on food reserves accompanies the rapid foliage production in May and June but these losses are almost completely replenished by late July. There is some loss of food reserves during the winter months.

(over)

*Three copies to be sent to the Office of Experiment Stations.

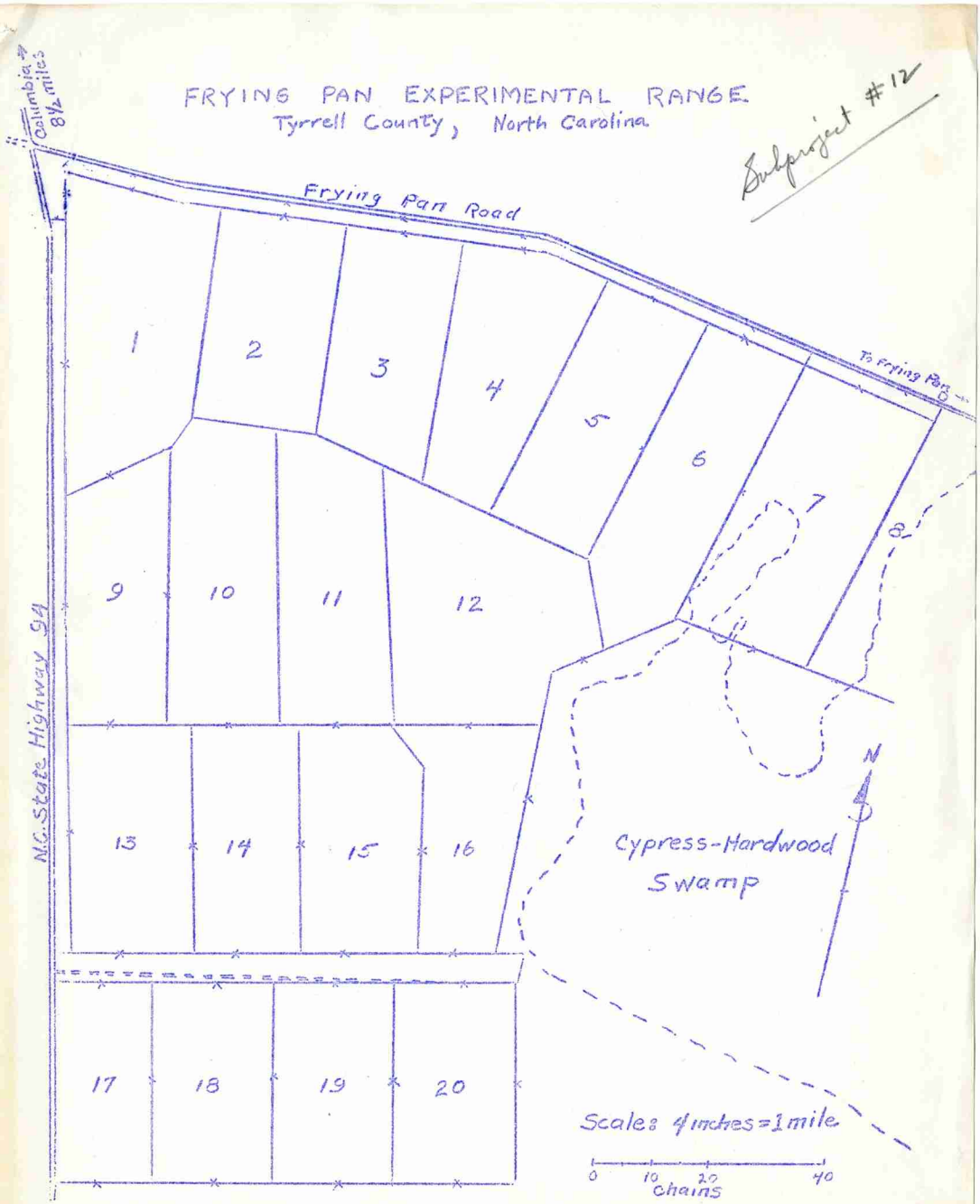
8. Practical applications and public benefits achieved or in prospect:

The results of this study will be particularly useful for determining the growth requirements of this species and for explaining the effects of different management treatments. Cattle producers interested in sustained grazing over a period of years will be vitally interested in this information in planning their grazing program.

9. Publications:

"The Application of the Total Available Carbohydrate Method to the Study of Carbohydrate Reserves of Switch Cane (Arundinaria tecta)". Plant Physiology Vol. 24, No. 2, pp. 285-294. 1949.

Director


FRYING PAN EXPERIMENTAL RANGE
Tyrrell County, North Carolina
Subproject #12
Columbia 8½ miles
Frying Pan Road
To Frying Pan
N.C. State Highway 94
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Cypress-Hardwood Swamp
N
Scale: 4 inches = 1 mile
0
10
20
40
Chains

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1950
(Three copies to be given to the OES examiner)

1. PROJECT: (Fund, number, and title): PURNELL ~~Agron.(f)~~ P14-11, UTILIZATION OF REEDS IN FOREST GRAZING.--11, FORAGE SPECIES AND CONSTRUCTION METHODS USEFUL FOR ESTABLISHING PASTURE FIREBREAKS IN THE POND PINE FOREST TYPE.
2. DEPARTMENTS AND COOPERATING AGENCIES: Animal Industry, Bureau of Animal Industry, U. S. Forest Service, N. C. Department of Agriculture.
3. PERSONNEL: W. O. Shepherd, E. U. Dillard, R. H. Hughes, and J. L. Rea, Jr.

4. NATURE OF WORK AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked):

Methods of constructing firebreaks in pond pine--reed type forests of the Coastal Plain are being studied at the Tidewater Experiment Station and the Frying Pan Experimental Range. Forage species (legumes and grasses) seeded on these lanes are being investigated to determine their usefulness as fire barriers and as a source of supplemental grazing in this area.

Cattle were grazed on these pasture strips intermittently from about April 1 to Dec. 1, 1949. The plots at the Tidewater Experiment Station were rated during the year on stand, vigor, resistance to trampling, and freedom from weeds. Highest ratings were given to redtop and ryegrass of the grasses and to ladino clover of the legumes.

5. BENEFITS realized by farmers or the public through application of findings, stated in dollars, bushels, or other values, where possible:

The development of economical and practical methods for establishing and maintaining effective firebreaks made up of good quality forage would help to solve a major forestry problem of the region and also encourage range cattle production.

6. WORK PLANNED FOR NEXT YEAR:

The performance of each species and mixture will be evaluated periodically, and the inflammability of ground cover under grazing conditions will be tested during critical fire seasons.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

8. APPROVED: _____ _____
Project Leader. Director.

P-14

FOREST GRAZING

PROJECT ANALYSIS
for the
COASTAL PLAIN OF NORTH CAROLINA

THIRD REVISION
- May 1950 -
by
W. O. Shepherd and E. U. Dillard

A cooperative project
of
The Agricultural Experiment Station
of the
North Carolina State College of Agriculture and Engineering
with
The North Carolina Department of Agriculture
and
The Forest Service and Bureau of Animal Industry
of the
United States Department of Agriculture

TABLE OF CONTENTS

FOREWORD

The aim and purpose of this analysis is to provide a current appraisal of forest grazing problems in the Coastal Plain region to serve as a guide for the research program. Because of the large number of cooperating agencies involved, such an analysis is particularly useful for providing a general understanding of the problems involved, the studies undertaken, and the methods of attack.

In two previous project analyses (1942 and 1945) studies were designated as "subprojects" and assigned numbers. When subprojects were closed out others were given the same number. This numbering practice and the term "subproject" has been a source of some confusion in the records of one participating agency. Therefore, we propose to substitute "study" for "subproject" and assign consecutive numbers, continuing from numbers assigned to the subprojects in the 1945 project analysis and the supplement of 1947.

It is also proposed to indicate in the title of a study the major aspect of forest grazing with which it is primarily concerned. In the present analysis, problems are classified under three major aspects: (1) forage or range management, (2) cattle management, and (3) integrating grazing and forest management. These could be considered as lines of work (line projects), although they are closely related aspects involved in grazing forest lands of the Coastal Plain.

This analysis is only considered to be applicable to the immediate future. It should be revised and brought up-to-date within five years.

AN ANALYSIS OF FOREST GRAZING PROBLEMS IN THE NORTH CAROLINA COASTAL PLAIN, PARTICULARLY THE TIDEWATER SECTION

INTRODUCTION

The U. S. Department of Agriculture Appropriation Act of Fiscal Year 1940 provided for the establishment of forest grazing research in Southeastern United States on a cooperative basis between Federal and State Agencies. Georgia and North Carolina were designated as the participating states, and the Forest Service, and the Bureaus of Animal and Plant Industry as the Federal agencies representing the U. S. Department of Agriculture. In North Carolina, the Agricultural Experiment Station of the State College and the N. C. Department of Agriculture have been the active state cooperators.

After a preliminary survey of forest grazing practices and conditions in 1940-41, a project analysis, with working plans for the initial studies, was formulated in 1942 (11)[1/] and revised in 1945 (12).

From the initial analysis it was concluded that forest and forage conditions in the Coastal Plain region were more suited to forest grazing than were those of the Piedmont and Mountain Regions. This conclusion has since been substantiated by limited research in the mountains by Biswell and Hoover (6) and in the Piedmont by Kaufman (18). Within the Coastal Plain, the tidewater section appears to have the highest grazing values and greatest opportunities for expanding forest grazing on a sound and profitable basis. Therefore, research effort has been concentrated in the tidewater section.

The purpose of the present discussion is to review the current status of forest grazing problems in the Coastal Plain, particularly the tidewater section, in the light of recent developments and research findings.

1/ Figures in parenthesis refer to "LITERATURE CITED", page 51.

TERRITORIAL CHARACTERISTICS

Although the present report is based entirely on data collected in North Carolina, the principal conclusions probably apply also to southeastern Virginia. As far north as the James River, at least, forest conditions in the tidewater section appear to be quite similar to those of northeastern North Carolina. This analysis therefore can be broadly construed as applying to the territory of the North Coastal Plain Branch of the Southeastern Forest Experiment Station.

A general description of the North Carolina Coastal Plain is given in the previous analyses of forest grazing problems (11, 12) and in the forest management problem analysis for the territory (28).

It is pertinent to mention here that the tidewater section and the western Coastal Plain are fairly distinct topographic areas. The tidewater section comprises, roughly, the eastern one-third of the Coastal Plain Region. It is a low, level, poorly drained region characterized by extensive, almost impenetrable swamps. Only a small proportion, perhaps one-fourth, of the tidewater section is cultivated. Extensive drainage would be required to increase the cultivated area. The western Coastal Plain is higher in elevation and fairly well drained. It has a gently rolling topography but slopes are usually not steep enough to cause serious erosion when the soil is disturbed. From one-third to one-half of the land in this section is under cultivation.

The Coastal Plain as a whole is a forest and farm region, approximately one-half in farm ownership (2). Forest land accounts for 64 per cent of the total area and cropland 30 percent (Table 1). Agriculture is the leading industry. The principal crops, approximately in order of cash value are tobacco, corn, peanuts, cotton and potatoes (26). Beef cattle production has been a minor item in the agricultural economy even though agricultural agencies have long been urging farmers to increase livestock production. Pasture accounted for less than three percent of the agricultural acreage in 1937. Reliable figures on recent pasture acreages are not available, but general observations indicate relatively small increases in pasture acreage during recent years, particularly in the tidewater section. It seems that any great increase in beef production in the tidewater section during the immediate future will probably occur on forest or "wild" grazing land -- for the following reasons: 1) Farmers have shown little inclination to convert to pasture their high-priced land on which they are producing specialized crops under intensive management. 2) Although relatively cheap uncultivated lands are available, the costs of draining and establishing improved pastures on them are very high. 3) Rather extensive areas of good quality native forage is available and unused. Much of this potential grazing land is in large holdings adapted to an extensive type of cattle production.

The major forest types are listed in Table 2. The forests are generally understocked and overcut. Almost half of the forest stands were classified as under sawlog size in 1937. Considering the heavy cutting during the war years it is probable that the condition of the forests has not improved, and presumably most forest tracts will not be in full timber production for many years. This is particularly true in the pond pine-hardwoods type where two-thirds of the stands were under sawlog size in 1937. One-fourth million acres were classified as clear-cut. About half of this amount is the "open land" in Dare, Hyde, Tyrrell, and Washington counties where fire, rather than lumbermen, is primarily responsible for the devastation. Much of this clear-cut area, and also poorly stocked pond pine type produces usable forage.

About 95 percent of the forest land is privately owned and approximately half of this was in farm woodlands in 1937. The remainder was owned by pulp and paper companies, lumber companies, investment concerns, railroads, and private estates. Approximately 20 percent of the forest area is in holdings larger than 10,000 acres. These large holdings are most common in the tidewater section.

Table 1.--Total land area of the Coastal Plain of North Carolina classified according to land use, 1937 [1/]

Land Use	Area (acres)	Proportion of total (%)
Forest [2/]	9,603,600	64.1
Nonforest:		
Agriculture:		
Cropland	4,515,300	30.1
Pasture	134,500	0.9
Total agriculture	4,649,800	31.0
Abandoned cropland	84,000	0.6
Other nonforest	652,600	4.3
Total nonforest	5,387,200	35.9
Total area	14,990,800	100.0

1/ Consolidated from tables of North Carolina Units 1 and 2 of the Forest Survey.

2/ Includes 13,800 acres of non productive forest.

Table 2.--Forest land area of the Coastal Plain classified according to forest type, 1937 1/

Forest Type	Area (acres)	Proportion of total (%)
Loblolly pine-hardwoods	4,229,400	44.1
Bottomland hardwoods	2,027,400	21.1
Pond pine-hardwoods	1,956,900	20.4
Longleaf pine	814,800	8.5
Upland hardwoods	561,300	5.9
Total	9,589,800	100.0

1/ Consolidated from tables of North Carolina Units 1 and 2 of the Forest Survey.

HISTORY OF FOREST GRAZING

Coastal Plain forests were grazed much more extensively in the past then they are at the present time. Local residents report that thousands of semi-wild cattle roamed the forests and swamps of the tidewater section prior to 1920. By custom and tradition, forest range was "free range" and the cattle owners were not held responsible for trespass on unfenced land. Range burning was a common practice which fostered the usual antagonism between timber and cattle interests. In this instance the timber interests gained the upper hand with the aid of an unusual but potent ally -- the Texas fever tick.

In the early 1920's an intensive, nationwide campaign was conducted to eradicate the Texas fever tick. All cattle were required by law to be dipped periodically. At this opportune time, state laws were passed requiring owners to fence or otherwise control their cattle. Rather than comply with the compulsory dipping and fencing, many cattle owners, accustomed to the freedom of open range, sold their herds and went out of the cattle business. Animals too wild to corral were hunted with rifles and shot down in the woods. As a result, very few of the former herds remained when the State was finally declared free of the fever tick in 1925. Cattle numbers were slow in building up again even on ranges which were known to be of high quality. Valuable forage remains unused on extensive tracts of excellent grazing land, only to accumulate as fuel for devastating wild fires. Local residents claim that fires have become more intense, although less frequent, since the range herds disappeared.

There are several possible explanations for this apparent neglect of a valuable resource. Most local farmers are accustomed to an intensive, "row crop" type of agriculture and they probably lack interest or training in cattle production. Also, a herd of cattle represents a considerable investment of capital which may not be available to the average farmer, and gross returns from the investment are not striking in comparison to those sometimes received from tobacco, cotton, potatoes, and other specialized crops. Then too, much of the best range land is owned by large lumber or pulp companies who have been interested only in tree products. And finally, the danger of destructive wild fires has undoubtedly discouraged investments in a range cattle enterprise.

IMPORTANCE AND STATUS OF FOREST GRAZING

In 1941, Biswell and Foster (2) estimated that forest range was providing 29 percent of the total sustenance of Coastal Plain beef cattle and equalled tame permanent pastures in contribution to the beef industry. Ninety percent of the cattle owners interviewed were using forest range for part of the year. During the remainder of the time the cattle were either on tame pasture, field crops, or harvested feeds. Most of the herds were small -- less than 125 head. A large proportion of the herds were started with native and dairy cows and graded up by the use of beef bulls. The number of purebred bulls had increased threefold from 1938 to 1940, indicating a general appreciation of the value of good breeding.

Cattle numbers and general interest in forest grazing appeared to be increasing rapidly at the time of the survey. The number of herds and number of cattle had nearly doubled between 1938 and 1940. It is doubtful that this trend continued but no reliable information is available to show the present status of beef cattle in this area because numbers of beef-type cattle are not published. Mr. Frank Parker, Agricultural Statistician of the N. C. Crop Reporting Service, recently[1/] examined unpublished census records from 1942 through 1948 for the Coastal Plain counties. He reported verbally that the records suggested a slight decline in the numbers of beef cattle during that period although dairy cattle had increased. He pointed out, however, that figures fluctuated widely from year to year and that the census samples were not reliable enough to draw conclusions from. The data further indicated that the decline was chiefly in the northern Coastal Plain counties. These counties contain the best forest range. Contrary to the census indications, Mr. J. L. Rea, Jr., Assistant Director in Charge, Tidewater Experiment Station, Plymouth, N. C., reports that beef cattle herds and numbers have definitely increased since 1942 in the general vicinity of the Wenona area where part of our range research has been conducted. The vicinity referred to includes portions of Washington, Hyde, and Beaufort counties. Nearly all of the herds in this area use native range during a large part of the year.

1/ August 1949

In 1941 most of the operators contacted were not making full use of their forest range and it seems reasonable to assume that there has not been a great increase in grazing use since that time. Most farmers said that the high cost of fencing was the chief deterrent to increased grazing use of their forest land. This suggests a need for developing systems of efficient management to obtain the greatest possible returns and a realistic evaluation of possible profits to be expected from forest grazing.

During the last few years, large companies have been showing considerable interest in forest grazing. A pulp and paper company in Martin County invested heavily in a range cattle enterprise during the recent war. Due to unfortunate events resulting from inexperience and poor judgment, the enterprise failed. They imported Arizona cattle and herdsmen, and ignored the advice of local cattlemen. Their cattle venture suffered heavy financial losses and was abandoned the second year. A local cattleman bought their surviving herd, however, and quickly made a handsome profit. Another large outfit, the Riegal Paper Corporation, started a program on their forest tract in Columbus County in 1946. This company has successfully integrated grazing with forest management for fire protection and cattle profit even though the quality of their native range is below the average of the Coastal Plain region.

The large landowners appear to be vitally interested in the fire hazard reduction and pine regeneration aspects of forest grazing, while cattle profit seems to be the primary concern of small farmers.

FORAGE TYPES

Five broad forage types, based on the most abundant palatable species, were recognized in the 1941 survey and all grazable areas examined were classified according to forage types present. The estimated relative importance of the five types in the Coastal Plain region as a whole is shown in Table 3. A considerable propertion of the forested area of the region has no grazing value because of very dense stands of unpalatable brush. No attempt was made to estimate the proportion of nongrazable area.

Table 3.--Relative importance of forage types in the Coastal Plain on the basis of acreage and grazing use

Forage type	Proportion of grazable range (percent)	Proportion of total range use (percent)
Switch Cane (Reed)	30	46
Woodsgrass	30	18
Broomsedge	25	33
Wiregrass	14	2
Marshgrass	1	1
Total	100	100

The switch cane, or reed, type was furnishing most grazing and the majority of farmers regarded it as the best native forage type. It is also one of the most extensive types, and since there are large areas of it not being used, this type seems to offer the greatest promise for expanding forest grazing on a profitable basis. Therefore, it was selected as the type deserving first attention in a forest grazing research program. This type is discussed fully later on in this report. It is particularly important in the tidewater section.

"Woodsgrass type" was applied to the heterogeneous mixture of panicum grasses (Panicum), beardgrasses or bluestems (Andropogon), sedges (Carex and Rhynchospera) and other herbaceous species characteristic of loblolly pine-hardwoods forests which have never been cultivated. This type is extensive in the western Coastal Plain but the forage cover is rather sparse. Its principal value is for spring and early summer grazing in connection with farm crops or pasture.

Broomsedge (Andropogon virginicus) is the most common grass on abandoned cultivated land and "oldfield" forests. It is most prevalent in the western Coastal Plain but occurs also in the tidewater section. It furnishes reasonably good spring forage and is often used to supplement lespedeza pastures which do not reach full productivity until late June.

The wiregrass type is typically found on sites which were originally occupied by longleaf pine. Here pineland threeawn (Aristida stricta) is the dominant grass. Another phase of this type, called "wiregrass savannah" or "prairie" occurs on flat terraces in association with pond pine. According to Wells (30) this type has resulted from the destruction of an earlier shrub-bog type by frequent fires which burned off the surface peat. Important grasses on these savannahs are Muhlygrass (Muhlenbergia), toothachegrass (Ctenium), pineland threeawn, sedges, and scattered switch cane. From the grazing viewpoint, the sandhill and savannah phases are quite similar. The foliage is fiberous and high in lignin content. When burned, however, this type provides good spring grazing. Although it is being utilized to a very limited extent at the present time, this type has considerable potential importance in grazing fire control systems and also as a source of forage during the critical period in early spring when other types such as switch cane are of limited value.

The marshgrass type is relatively unimportant, occurring only along the coast and sounds. Rushes (Scirpus, Juncus), cordgrass (Spartina), sawgrass (Cladium), and saltgrass (Distichlis) are among the important species. The marshgrass type is utilized most for winter grazing when other forage is scarce.

Other types are locally important and further refinement in forage type classification is desirable when more information is available. For instance, a panicgrass-sedge type is quite common along wet drainageways, particularly where the tree stand is open as a result of cutting or fire, and apparently provides good grazing through the summer months. Until the major forest grazing problems are solved for the more important forage types, however, it does not seem advisable to divert any appreciable amount of research effort to the minor types unless more facilities become available.

SWITCH CANE

The remainder of this report will deal primarily with the switch cane type which, as already pointed out, is considered to be the most important native forage type in the Coastal Plain of North Carolina.

Botanical Classification and Characteristics

There has been considerable confusion regarding the botanical classification of the plant we are calling switch cane (Arundinaria tecta). Most botanical manuals list two species of the genus Arundinaria: A. gigantea and A. tecta, differentiated on the basis of flowering habit. Individual plants, however, often have the key characteristics of both species, and recent investigators (15, 31) have concluded that there is in

reality only one species in North America. The valid name of that species has apparently not been definitely established. The type species for the genus is A. macrosperma Michx. which has been changed to A. gigantea (Walt.) Chapm. This suggests that A. gigantea, rather than A. tecta, might be the proper scientific name. Since much of the cane in our region corresponds to the size attributed in the manuals to A. tecta (usually not more than two meters tall") rather than to A. gigantea ("as much as 10 meters tall") the former name has been widely used. Wells, and Wells and Shunk have applied it to North Carolina cane in botanical publications since 1928 (30). The accepted common name for A. tecta, according to Standardized Plant Names (19), is switch cane. It is also called small cane, and in North Carolina it is generally known as reed. The larger forms have been called giant cane or southern cane. Perhaps it would be least confusing to use only the generic common name, cane.

Cane has the distinction of being the only bamboo native to United States. Its woody perennial stems grow erect from stout underground rhizomes. New branches and leaves are produced each year near the summit of the stems. Stems ordinarily live for several years but they are very sensitive to fire. The aerial stems are killed even by light surface fires which may barely scorch the stem bases and not consume dry leaves at the top of the stem. Cane sprouts vigorously from the stem bases and large rhizomes, however, and the stand is almost completely re-established the first growing season after burning if the rhizomes are not destroyed. Growth rates of 1½ inches per day for the new stems following later winter burns have been measured at Wenona (3).

Reproduction is essentially vegetative. As with most bamboos, cane flowers only once and then dies. Apparently an entire clone flowers simultaneously. The space it occupied is then invaded by rhizomes from adjacent cane which did not flower at the same time. Observations indicate that a very small percentage of the florets develop into seed and most of these are destroyed by insects before they mature. Once a stand of cane is completely killed, therefore, there is little chance of re-establishing it. Most rhizomes are within 8 to 12 inches of the surface on swampy sites and many cane stands on organic soils have been destroyed by ground fires which have burned off the top foot or so. Cane is also killed by continuous overgrazing, especially in combination with burning.

Distribution

The geographic distribution of cane extends from Virginia to southern Ohio and Illinois and south to Florida and east Texas. Extensive canebrakes formerly occurred on lowlands adjoining streams and rivers in the swamps throughout the southeast. The only extensive stands remaining today occur in the swamps of eastern North Carolina and Virginia, and in the bottomlands of the lower Mississippi River. Its decline is attributed to cultivation, fire, and grazing. On uncultivated lands, grazing is probably chiefly responsible.

In North Carolina it is most important in the tidewater section. Along rivers and streams, however, it extends throughout the Coastal Plain and even into the mountains.

Ecology

There is little factual information available pertaining to the ecology of switch cane. West's unpublished dissertation (31) is the most complete work we know of and it is more or less observational data. Many of the following statements, therefore, are based on personal observations.

Soil and moisture requirements

Switch cane makes its best development on deep, moist, fertile soils (along the Mississippi bottom lands) but tolerates a fairly wide range of edaphic conditions. Where heavy grazing has not been a disturbing influence, cane seems to be a sensitive indicator of site quality.

It often occurs on relatively dry and rather poor sandy sites and also in shrub-bogs where the water table is at the surface most of the time. In these unfavorable situations the cane plants are small and scattered. It does not occur in the wettest parts of shrub-bogs and other swamps, nor on the poorest upland soils. Perhaps the ideal cane sites are now in cultivation. At the present time the best stands in North Carolina are on organic soils which are above water during most of the growing season, and on the fertile lowlands bordering streams. It responds readily to drainage and good soil aeration as indicated by noticeably better growth in the proximity of drainage ditches. Very likely, it would also respond to fertilization although this has not been established experimentally. It has been shown, however, that the protein, phosphorus, and calcium content of cane foliage, as well as total foliage production, are much greater on good sites than on poor sites — using cane height as an indicator of site quality. It seems that switch cane would be an ideal plant with which to check the theory advanced by Albrecht of the relationship of calcium, potassium, and phosphorus to the protein-carbohydrate content of vegetative structure (30). It is claimed that calcium is correlated with high protein, and potassium with high carbohydrate. Therefore, the low calcium content, with relatively high potassium, of sandhill and shrub-bog soils is suggested as the cause for the highly fiberous and lignified type of vegetation on these sites.

Fire influence

Cane appears to be a "fire species" occupying an ecological "niche" comparable to pine. It is quite shade-tolerant and persists as scattered plants even under dense hardwood canopies. The relatively open pine canopies ordinarily existing in pond pine forests apparently have only minor effects on cane stands, but hardwood brush species are serious competitors.

Fire or other disturbances probably favor the cane in direct relationship to the proportion of tree and brush competition removed. Since ungrazed cane promptly regains its full height after burning, it is favored most by periodic fires which occur just often enough to keep the brush and tree canopy below that of the cane. Such periodic burning should result in almost pure stands of cane on good sites — provided the soil is not burned. The American Indians are probably largely responsible for the extensive canebrakes originally found in the Southeast, for the fact that fire was commonly employed by the Indians to drive game in well established by the writings of early explorers in this region (1, 20).

Association with other species

Because of the fire relationships, switch cane is commonly associated with pond pine. It also occurs with other pines and lowland hardwoods. In swamp areas it is frequently associated with cypress and gums, but for some unknown reason it apparently never occurs on cedar sites.

In shrub-bogs cane grows in mixture with many fire tolerant shrubs such as gallberry (Ilex), honeycup or zenobia (Zenobia), Swampbay (Persea), summersweet clethra (Clethra), greenbriar (Smilax), cyrilla or ti-ti (Cyrilla), lyonia (Lyonia), and huckleberries (Gaylussacia and Vaccinium). In such areas management of cane is very difficult because grazing of cane favors the competitive position of the brush. Burning temporarily favors the cane but the sites are too poor for cane to make a sufficiently dense stand to control the brush effectively.

Poisonous plants

Two species known to be poisonous to livestock, lambkill kalmia (Kalmia angustifolia) and Carolina Jessemine (Gelsemium sempervirens), are often associated with switch cane. Lambkill kalmia, a low shrub, is most prominent in acid bogs and was fairly abundant in the experimental ranges at Hofmann Forest. Carolina jessamine, an evergreen vine, occurs throughout the Coastal Plain and lower Piedmont. Other poisonous species such as water hemlock (Cicuta maculata) and crow-poison (Amianthium muscaetoxicum) may also occur with switch cane but they have not been observed in the experimental areas. Although farmers have attributed cattle losses to poisonous plants (2), the importance of such losses on forest range is not known. Very few losses at Hofmann Forest could be attributed to poisoning and no poisonous species occurred at Wenona. Poisonous plants unquestionably deserve further study but apparently the problem is not serious in the switch cane type. Poisonous plants are relatively unpalatable and cattle will not ordinarily eat harmful amounts of them unless forced to do so by hunger. Therefore, if adequate forage is provided the danger of poisoning will be largely eliminated. Poisoning is most apt to occur during late winter or early spring when desirable forage is limited.

Insects and diseases

Insect and disease damage to switch cane apparently offer no hazard, and drought has never been observed to affect this species appreciably. Therefore, cane offers a remarkably dependable source of forage.

An infestation of army worms in July and August destroyed about 15 percent of the cane forage at Wenona in 1941. This is the only recorded evidence of forage damage by insects. The infection occurred on freshly burned range and during an extreme drought. Insects commonly destroy the seed of cane but it is doubtful that seed is of any consequence in natural reproduction of cane.

An unidentified "stem borer" has been observed to contribute to the death of old stems, but relatively few stems are killed in any one year and this source of damage is thought to be of minor importance.

Over the past four years, a physiological condition and a disease of cane foliage have been observed to be associated with autumnal leaf shedding. Although these observations are primarily of philosophical interest, they might possibly have some significance in relation to management, particularly for winter forage.

When growing in full sunlight, cane foliage begins to acquire a yellowish cast in late summer. As the season progresses the yellowing increases until the leaves fall to the ground. The older leaves are the first to shed. The yellowing is due to minute chlorotic spots, the result of chlorosis of individual cells or groups of cells. Microscopic examination has revealed no pathologic organisms in these spots and their distribution in the leaves suggests a physiological origin.

Another leaf condition which has a more definite effect on leaf shedding, but which is not so general in occurrence, resembles a leaf blight. Lesions, commonly beginning near the tip or edge, progress downward or inward until most of the leaf is killed. Badly infected leaves drop off. This blight is apparently pathogenic because the lesions are covered with small dark-brown or black fruiting bodies of some organism, located like dots between the veins of the leaf.

The chlorosis commonly affects the older leaves and in contrast the new growth has a distinctly darker appearance. The blight, on the other hand, affects old or young leaves alike. It has been observed to kill the rolled terminal leaf during the active growth stage and thus arrest further growth on affected stems.

Summary of Previous Grazing Research in the Cane Type

Throughout this report are references to past findings as they apply to particular phases of the grazing problems in the cane type. At the expense of repitition, the principal results of studies at Wenona and Hofmann Forest, the two former work centers of grazing research, are briefly summarized here.

First it would be well to characterize the range conditions at the two locations.

The Wenona ranges were located in Washington County at the site of a cypress-hardwood forest, approximately 16 feet above sea level, which was logged and drained in the early 1900's. A small portion of the drained area was put into cultivation; the remainder has been subjected to frequent wildfires which killed the remaining trees and prevented tree regeneration. The dense and vigorous cane stand that developed on these organic soils was apprently well above the average for the region. Cane has been eliminated from a large part of the area by recent severe fires, particularly during the last 10 years, which have burned the soil to depths up to 18 inches in a single season.

Hofmann Forest, in Jones and Onslow counties, is mainly an open pond pine forest, with a dense understory of shrubs, on poorly drained sandy muck soil. Scattered canebrakes occur on sites intermediate between the very wet "pocosin" and the sand ridges. The cane stands are of moderate height (two to five feet) and are always mixed with shrubs. Consequently, grazing values are rather mediocre. A few of the shrubs are palatable and suitable for browse. Palatable ferns are also abundant and furnish much spring grazing. The winter ranges also contained a considerable proportion of savannahs, thought to be relicts of shrub-bogs destroyed by ground fires. Like the wiregrass type, the savannahs actually have little grazing value unless they are burned. The entire forest has apparently been subjected to frequent wildfires since early colonial times.

Results at Wenona

Research on native range began about 20 years ago at Wnona. Although early studies were primarily aimed at comparing breeds of cattle, they demonstrated the high quality of cane forage (10). Over a five-year period, cows grazing cane range from May to January 1 (sometimes February 1) gained 0.4 pounds per day and produced a 95 percent annual calf crop. Calves gained one pound per day and weighed between 330 and 400 pounds when weaned at 7 to 10 months of age. Similar cow and calf gains obtained in more recent studies have further demonstrated the value of cane forage. Also, limited digestion trials have indicated that the total digestible nutrients in cane forage at Wenona compare favorably in early summer with other green forages commonly used by cattle (8).

Cane forage here contained between 18 percent and 12 percent crude protein from May through December, well above the approximate minimum requirement (nine percent) for breeding cows. However, there were slight deficiencies of calcium in the early summer, and of phosphorus in winter.

On this good range, creep feeding of calves did not increase calf gains enough to make this practice worthwhile (14).

Rotational grazing, where cattle were shifted between ranges at 28-day intervals or in mid-summer, gave results similar to continuous grazing as tested under a moderate degree of utilization. A pertinent feature of this study, however, is the indication that grazing can be deferred without sacrificing cattle gains.

A three-year study of different intensities of continuous summer grazing showed that cane is easily weakened by over grazing. Apparently, at least 30 percent of the total foliage must be left at the end of the grazing season (December) to maintain satisfactory vigor and productivity of the forage stand. Although moderate grazing produced best cattle gains in the long run, cattle weights did not reflect overgrazing until late in the season and after approximately 80 percent of the forage had been utilized.

Three acres of good cane range per cow was found to be adequate for a seven month season at Wenona.

Grazing reduced fire hazard in direct relation to the degree of grazing. Three years of heavy grazing (80 to 90 percent utilization) resulted in a 70 percent reduction in total combustible material (living and dead) as compared to very lightly grazed or ungrazed canebrakes. Good fire protection, however, was obtained at the expense of vigor and productivity of the forage stand.

Open grown cane has not been a dependable source of winter forage at Wenona because most of the foliage drops in January or February.

Steers have been partially and entirely fattened for market by feeding concentrates while on range, cane replacing hay as roughage in the fattening diet. The financial aspects of this practice, however, have not been completely analysed.

Results at Hofmann Forest

Grazing values were considerably lower here than at Wenona. Although the crude protein content of cane foliage was apparently above the minimum requirements from May (13 percent) to December (10 percent), it was four or five percent lower than at Wenona. Similarly, cane forage contained less calcium and phosphorus and was deficient in these minerals most of the year. Also, the forage was apparently somewhat less digestible at Hofmann Forest (8).

Grazing capacity at Hofmann Forest was not well established (experimental ranges were inadvertently overgrazed) but apparently the average capacity in cane areas was approximately 1.5 to 2 acres per cow month.

Calf crops averaged between 60 and 70 percent, and calves at weaning time usually weighed between 275 and 300 pounds — almost 100 pounds less than at Wenona. Although overgrazing may be partially responsible for the relatively poor cattle performance at Hofmann Forest, forage quality was probably a contributing factor also. It seems reasonable to assume that the forage quality and cattle performance measured at Hofmann Forest are about the minimum to be expected from cane range, because the experimental ranges apparently approach the lower limit of site quality tolerated by this species.

By feeding four to six pounds of cottonseed meal per head daily from January through April, the breeding herd was successfully wintered on the range at less than the usual cost of wintering on a farm with harvested feeds (12). It was thought, however, that a better practice would be to start feeding two pounds in December and increase the rate gradually to 6 pounds by April.

Relationships between grazing and forest management was an important phase of the Hofmann Forest studies. In general, grazing was found to be compatable with forestry.

Grazing favored pine seedling establishment (five-fold on unburned areas) and also increased the growth rate of small seedlings (67% for the 6 to 12-inch height class), but had no apparent effect on seedlings taller than three feet.

Grazing increased mortality of very small seedlings about 12 percent, but had no affect after they were a foot tall. Damage was apparently due to trampling — no appreciable browsing was detected.

Logging had no measurable effect on pine seedlings nor grazing value.

Relatively few pine seedlings became established during the study except on areas accidentally burned. Apparently fire is essential for adequate regeneration of pond pine.

The performance of three separate wildfires demonstrated that grazing definitely reduced fire hazards. In spite of the prevalence of unpalatable shrubs, plot measurements showed that fuel was reduced 50 percent after two years of heavy grazing. The density of cane and palatable shrubs was also reduced to about half of the original stand by heavy utilization.

FORAGE MANAGEMENT IN THE SWITCH CANE TYPE

Of the numerous kinds of native plants associated with switch cane, at least two dozen are eaten in sufficient quantities to warrant recognition in the cattle diet at some season of the year (3). Management of the forage type, however, should be based almost entirely on the cane because it is by far the most important and most valuable single species. Other species should be considered as incidental or supplementary, although they may be important for emergency forage in winter and early spring.

Sustained productivity of high quality forage is ordinarily the major objective of range management. In Southeastern forest ranges, however, fire hazard reduction and pine regeneration are additional aspects for range management which may sometimes be more important than forage yields. These special aspects of management will be treated separately and, unless otherwise mentioned, management of cane ranges will be discussed primarily from the viewpoint of maintaining sustained forage yield.

Pertinent characteristics and growth habits

There are several unique characteristics of the growth habits of switch cane which are pertinent to its utilization and management.

Of major importance is the tendency of the foliage to remain green and intact on the stems most of the year. This is particularly true of shade-grown leaves. Beneath a tree canopy, one-third to one-half of the leaves usually are still green and intact when new growth begins in the spring. In forest stands, therefore, cane can be grazed at any season. In the open, however, most cane foliage dies and drops off by mid-winter and open stands are ordinarily usable only through December, though some of the lower leaves may persist throughout the winter if the cane is dense. The shedding of leaves has usually been attributed to frost (3), but as discussed in the section on diseases, there are indications that other factors may also be involved.

Even though the grazing season is unusually long, most of the total forage is produced during a restricted period in late spring and early summer. Foliage growth on old stems begins in April and is completed in July. Active growth of new culms or stems usually occurs somewhat later, from May through August or September. New stems account for a relatively small percentage of the total forage in dense stands but stem production increases as the old stand is thinned out by the mechanical effects of grazing or otherwise. When the old stand is removed by fire or mechanical means, new stem growth begins earlier, usually in late April or early May.

Characteristically, cane has five or six primary leaves per branch, in addition to one or two small, bract-like leaves. The leaves are produced one at a time at intervals of about two weeks. The growing point is terminal and foliage growth is complete when there is a fully developed leaf at the tip of the branch. It is convenient, therefore, to refer to the stage of development during the active growth period in terms of the number of leaves per branch, i.e., first leaf stage, fourth leaf stage, etc.

Plot studies at Hofmann Forest have shown that very little regrowth occurs when cane is defoliated after active growth is completed but considerable regrowth follows utilization during the active growth period. Relatively few small leaves were produced in August and September on plots defoliated in mid July (early full leaf stage) and practically no regrowth followed September defoliation. Plots defoliated in May (second-leaf stage) however, produced abundant new foliage. A large percentage of the leaves must be removed to induce appreciable regrowth. No regrowth occurred where only 20 percent of the leaves were harvested from individual stems each month, and only limited regrowth followed 40 percent utilization. It was noticed that removing part of the branches early in the season increased the size of the leaves produced later on the remaining branches.

These plot studies indicated that a heavy utilization early in the active growth period is not particularly detrimental if the plants are allowed to recover during the remainder of the season. Heavy defoliation in July, however, did not allow for sufficient regrowth and vigor declined. Defoliation in September caused some of the cane to break dormancy late in the fall and a large percentage of the stems died (presumably from winter killing), although the vigor of the stand appeared to hold up fairly well (as indicated by subsequent new stems). Heavy defoliation in early winter (late November) had very little effect.

The rhizomes and stems of switch cane serve as storage organs for a tremendous amount of plant food. A preliminary investigation at Hofmann Forest (21) revealed that available carbohydrates (starches and sugars) made up as much as 26 percent of the dry weight of rhizomes and 11 percent of the stems. Even the mediocre stands of cane at Hofmann Forest have approximately four tons (dry weight) of rhizomes per acre and about two tons of stems. This represents over a ton of available carbohydrates per acre. The food reserve may fluctuate widely during the season, being lowest during the period of rapid growth and highest in the fall dormant period. Heavy grazing during the active growth period, when food reserves are low, would be expected to further deplete the reserves and weaken the cane. If, however, the regrowth is protected during the remainder of the season the reserves are apparently replenished adequately. The reserves apparently are still rather low at the early full-leaf stage, and defoliation then (July) may not allow for sufficient regrowth or sufficient time to restore food reserves to a high level. The indications are that by early fall (September) reserves in protected

cane are near the maximum level and ill effects of utilization then or later would seem to be from causes other than food depletion. Burning a cane stand undoubtedly depletes food reserves to a low level. Not only are the stem reserves destroyed, but also the new stand of aerial stems must be produced at the expense of the rhizome reserves. There are indications that three growing seasons after burning were required to completely replenish the food reserves of the cane stand studied at Hofmann Forest.

More information of a definite nature is needed on some of the growth characteristics and requirements of cane, but it is already apparent that growth habits and physiological processes must be kept in mind to manage this species intelligently.

Forage management systems

Most of our forest grazing research in North Carolina has been conducted under the continuous grazing system, where cattle are kept on one range throughout the summer and moved to another range or to a farm in winter. It is difficult to make efficient use of the forage and at the same time maintain the density and vigor of the cane stand under this system. Cane is particularly vulnerable to over-use because all of its foliage is well off the ground and readily accessible to cattle. At Hofmann Forest, the density of the cane stand was reduced about one-half, and the vigor equally as much, by two seasons of unintentional over-use. Even though rates of stocking were reduced 50 percent the next two years the grazing capacity of the weakened cane had declined and the cane was not able to recover appreciably. Preliminary results from hand-harvested plots at Hofmann Forest indicate that 60 to 70 percent defoliation at the end of the grazing season (October or November) is the maximum allowable degree of use with continuous grazing. Results at Wenona, also, have shown that utilization must be carefully controlled under continuous grazing if high forage productivity is to be maintained. There, it appears that 60 to 75 percent utilization of total herbage at the end of the season in November and December are the safe upper limits. This implies that only one-third of the total foliage should be used up by the end of August. In order to insure light utilization during the spring and summer, which appears to be the most critical period, it seems desirable to base the rate of cattle stocking on the longest season possible. Repeated observations have shown, however, that cattle seldom utilize a cane range uniformly, and some portions of a range will often be very heavily grazed before other portions are scarcely grazed at all.

In tall cane, grazing rates which are light enough to maintain good plant vigor may still thin out the cane stand under continuous grazing. Cattle first eat the low foliage within easy reach (below four feet) and utilize this layer heavily before taking much of the upper foliage. New basal shoots, being succulent and highly palatable, are sought out and kept grazed off. Thus, new stems are largely eliminated and as the old stems die from breakage or other causes, the stand of cane gradually thins out even though the remaining cane is vigorous and productive. This effect may not be important on ranges where the cane is less than six feet tall but it was quite apparent at Wenona.

Management of winter range is not a problem from the standpoint of maintaining the vigor of the stand, although there may be possibilities for increasing the proportion of green forage in winter by manipulating the management. There is definite need, however, for a system of grazing which is less apt to weaken or thin out the cane stands than is continuous summer use.

Two rotational systems were compared with continuous summer grazing at Wenona from 1941 through 1944 (5). The pertinent conclusions to be drawn from the study are that cattle gains were similar under all three systems tried: 1) continuous grazing, 2) mid-season rotation, and 3) 28-day rotation. This indicates that a range can be deferred at least until mid-August without affecting cattle gains. Interpretation of vegetation responses in this study was complicated by wild fires which burned over the experimental ranges in 1941, 1942, and 1943. Differential effects on the forage stand from the three systems of grazing could hardly have been expected, however, under the rates of grazing applied. On most pastures, only 25 to 45 percent of the cane foliage was utilized at the close of the season. This degree of use is probably not harmful under any system of use. Heavy utilization was obtained in 1944 on one replication of pastures heavily burned the previous year, but this was the last year of the study. Rotational grazing, therefore, has not been thoroughly investigated on switch cane ranges.

Considering the growth habits of cane, a 28-day rotation system has no apparent advantages over continuous grazing.

A mid-season rotation, where the cattle graze one half of a range early in the season and the other half late, should be somewhat better than continuous use. By mid-season, approximately August 15, the new shoots have had time to make most of their growth and they may not be killed even if the top half were eaten. Therefore, this system would possibly maintain stand density adequately. But whether forage vigor can be maintained easily on the early-grazed range with this system is questionable. As already pointed out, cane apparently makes only limited regrowth after July. Therefore, it would probably be necessary to control early utilization almost as carefully with this system as with continuous

grazing. With more information on the degree of utilization tolerated at different seasons of the year, the mid-season rotation system might be adjusted so that it would meet the requirements of switch cane. The current "grazing capacity" study at Tidewater Station (Subproject No. 12) will be helpful along this line since it will show the effects of heavy utilization at different seasons.

The ideal system of management would be one which would allow full use of the forage, maintain the vigor and productivity of the stand, and be simple to apply. It seems that a rotation system, where grazing was alternated between summer and winter, would most nearly meet these requirements. Such a system would require that the range be divided into two parts of approximately equal capacity. Each part would be grazed continuously for a full year, beginning with the winter period, and then rested a full year. Since the forage produced during the summer rest period would be utilized the following winter, no forage would be wasted. Heavy winter use does not seem to be harmful, and, with an entire season for recovery, heavy use during alternate summers may not deteriorate the cane stand. If this were the case the system would be easy to apply since it would not require careful control of utilization.

For open ranges not adapted to grazing in late winter, the suggested system would need some adjustments. Two possible schemes, involving only two ranges, are as follows: 1) graze one range early in the season and the other late, but rotate the season of use so that early grazing one year will be followed by late grazing the next year. 2) Graze seasonlong (even though heavy grazing results) but use a particular range only on alternate years, thus allowing a full year for recovery.

Degree of utilization

The determination of the degree of utilization commensurate with sustained forage yields, i.e., proper use, is a fundamental problem of forage management. The proper degree of utilization will, of course, depend on the system of management, season of grazing, and perhaps site factors.

To date, proper use has been studied only for continuous summer-long grazing. With this system of management, studies at Wenona have been adequate to show that 60 to 70 percent utilization by December 1 is the maximum proper use on highly productive sites. Limited data from plot studies at Hofmann Forest indicate that a similar degree of utilization is applicable to lower quality ranges on relatively poor sites. Final evaluation of the plot study, however, is pending until food reserves of the treated cane have been analyzed. If it is found that proper use is independent of site quality (and cane size), management problems will be greatly simplified and the results of research in a limited area will have wide application.

In order to devise improved systems of management, it is necessary to know the degree of use that switch cane will tolerate during restricted seasons. Studies already underway are expected to reveal the seasons when cane is vulnerable to grazing and also when it is resistant. The next step will be to determine the proper degree of utilization during the periods when it is sensitive to over-use. It has already been found that total defoliation in July or in September is harmful. Heavy utilization at five different "seasons" is now being investigated at Tidewater Station. The seasons are: 1) May - June, 2) July - August, 3) September-October, 4) November - January, and 5) February - April. These correspond to the following stages of growth or development of switch cane: 1) rapid growth (food reserves decreasing), 2) late growth and full leaf stage (food reserves increasing), 3) growth dormant (reserves increasing), 4) early winter (leaves beginning to shed), 5) late winter (green foliage limited). Results from this study should begin to show up in 1950, although the study should run at least through the third year, 1951.

Grazing capacity

The first requirement of efficient management is a determination of range grazing capacity, or amount of available forage. To date no satisfactory method of evaluating grazing capacity of switch cane ranges has been devised. The capacity of the highly productive range at Wenona has been quite accurately established but only after years of experience with the "trial and error" approach. At Hofmann Forest, the capacity of the experimental ranges was greatly over-estimated at the beginning of the studies. Since the cane stand was severely damaged before the stocking rate was adjusted, we have no reliable standard of correct carrying capacity for medium and low quality cane range. Because of the great variation in the productivity of cane stands, not only between different parts of the region but also on different sites within a relatively restricted area, it is almost imperative that procedures be developed for estimating carrying capacity with reasonable accuracy.

The amount of forage can be measured directly, of course, by harvesting sample plots. But the labor involved in sampling an entire range adequately by this method would be exorbitant. Forage weight estimates, which are more quickly obtained than harvested weights, have been found to be satisfactory on some types of forage in the West. This procedure has not been investigated in the switch cane type. The most common methods used in range appraisal involve estimates of foliage "density", or percentage ground cover. The density data are converted to grazing capacity by certain "productivity" or "proper use" factors which evaluate the relative amounts of usable forage represented by a unit of density of individual species. This is a rapid method of range appraisal and preliminary tests indicate that it can be used in the cane type. It has some weaknesses, however, in that it is based on subjective measures, requires trained technicians, and is difficult to use in very tall and dense vegetation.

A study has been started at Tidewater Station (Subproject No. 12) to develop reliable criteria for estimating carrying capacity of switch cane range. The density method is being investigated in this study and also more objective measurements such as the number of stems per unit of ground surface, size of stems, and the number and size of leaves per stem. The data are being evaluated in terms of forage yields and cow days of grazing. From one year's results it appears that the density method can be successfully applied to switch cane if adjustments are made for cane height and tree canopy. No simple relationship between stem numbers and grazing capacity is apparent from the first year's data. Apparently the number and size of leaves must also be recognized. After the second year's results are available, an attempt will be made to develop a precise method of range appraisal and also one suitable for use by farmers or county agricultural agents without special training. These methods will need to be checked on herd-size ranges.

Research techniques

The accuracy of research results largely depends on the techniques employed. Relatively little research effort has gone into the development of efficient techniques for evaluating forage management studies in the switch cane type. Because of its unique characteristics, methods developed for other range types may not be directly applicable to switch cane. Some technique problems have already been mentioned in relation to estimating grazing capacity. We also need to know more about the numbers and sizes of plots required for efficiency in sampling ranges and evaluating treatments. Methods of determining degree of utilization accurately are also needed.

The need for more efficient techniques is illustrated by the results at Hofmann Forest where uncontrolled variability among pastures largely masked the differential effects of the grazing treatments applied. The results here also emphasize the desirability of evaluating forage responses quickly before the cane stand is seriously weakened or killed. Criteria for recognizing and measuring the vigor of cane stands should be developed at an early date. Some information on leaf size, new stem production, etc., useful for this purpose was obtained at Wenona (Subproject No. 1) and in a plot study at Hofmann Forest (Subproject No. 9). Additional data are being collected at Tidewater Station (Subproject No. 12).

For experimental purposes, a physiological approach in measuring cane vigor may be efficient and practical. Food reserves have been shown to be associated with plant vigor in cultivated and native forage species (16, 22, 23). As already mentioned, switch cane is known to possess the facilities for rather remarkable food storage capacity in its stout rhizomes and perennial stems. It is highly probable that the cane food reserves are depleted by mismanagement before other evidences of reduced vigor are apparent. It seems logical, therefore, that a measurement of the food reserves might be helpful for an early evaluation of management practices before deterioration in vigor has progressed to the stage where the stand is seriously damaged. A simplified procedure for chemically

analyzing the food reserves of switch cane has already been worked out (21) and found to be sensitive to seasonal fluctuations in food reserves. The method is also being applied to a plot study (Subproject No. 9) to test its sensitivity in measuring the effects of different intensities and seasons of utilization of cane foliage. If the method proves to be efficient, it should be given full consideration as a standard technique in switch cane management research.

CATTLE MANAGEMENT ON CANE RANGE

Beef cattle production is commonly divided into several distinct phases which may be carried on independently or in succession as a part of a continuous process which may involve all phases. A rather generally accepted classification of these phases is as follows:

1. Production of slaughter calves.
2. Production of stocker cattle.
3. Production of fat market cattle as yearlings or older.
4. Baby beef production.

The first two phases are those normally associated with range grazing and it is these phases with which we are primarily concerned. Production of fat market cattle is ordinarily a farm or feedlot operation although it may have a limited place in forest grazing in conjunction with the best cane ranges. Baby beef production is a highly specialized phase, usually found only in the corn belt states, involving the use of highly nutritious feeds, mostly concentrates.

Production of slaughter calves

In 1937, Foster, Hostetler, and Case (10) reported that in studies at the Blackland Branch Station (Wenona) the average weaning weight of grade calves produced on switch cane pasture was about 330 - 385 pounds when approximately eight to nine months of age. The beef was produced entirely on range and the calves were offspring of native cows.

Later studies (14) at the same station indicated that calves could be weaned averaging 390 pounds or more off switch cane ranges. Calves used in these later studies were from daughters or grand-daughters of the old native cows and were three-quarters to seven-eights Hereford.

At the Hofmann Forest, where the forage is supposedly of poorer quality, calves have generally gained from 50 to 100 pounds less than the calves produced at Wenona. It is interesting to note, however, that for the first year or so that cattle were grazed at the Hofmann Forest the weaned weights of the calves were quite comparable to those of the Wenona calves. It would seem from such indications that limited quantity as well as quality may have caused poor gains at the Hofmann Forest.

Four years' work on creep feeding of calves on the Wenona range in an attempt to produce heavier and fatter weaned calves showed little advantage for creep feeding. There did seem to be an advantage for the last month or so prior to weaning, but the feeding was not profitable for the season.

No experiments with creep feeding have been conducted on range of lower quality than that at Wenona, but a one year preliminary test at Hofmann Forest indicated that creep feeding may be practical there. The calves ate the supplement well and made good gains. Since the Wenona range is recognized as one of the best in the Coastal Plain area, and in view of the fact that many investigators (7, 17, 29) have found creep feeding profitable, it would seem advisable to conduct further studies on ranges of average quality.

One of the major problems, if not the major problem, in the production of calves in the Coastal Plain area is that of increasing the percentage calf crop. Even the production of 500 or 600 pound calves at weaning could not be very profitable with a 40 to 50 percent calf crop. This kind of calf crop has not been unusual at Hofmann Forest. The problem seems primarily to be one of nutrition. For many years the calf crop at Wenona ranged from 85 to 100 percent with only an occasional bad year. Cows were generally wintered at the farm and kept in rather good condition. At Hofmann Forest the cows were wintered on the range at a lower state of nutrition than at Wenona, as indicated by their weights. Difficulties involved in servicing several separate experimental groups of cows with one bull may have contributed to low calf crops but it is thought that the nutritional level of the cows, particularly during late winter, was partially responsible. Cows tended to calve in alternate years -- a further indication of poor nutrition.

Different amounts of protein supplements fed to the cows during winter did not materially effect the calf crop in studies conducted at the Hofmann Forest over a six year period. It may have been, however, that the nutritional state was somewhat low in all instances. Certainly the problem is one deserving further consideration.

Production of stocker cattle

The production of stocker cattle, while generally considered a phase of beef production, is a step in the overall process aimed primarily at supplying cattle for the feed lot or supplying replacements for the breeding herd. Stockers are any cattle kept beyond weaning for future use in the feed lot or herd. Hence, many of the problems involved in producing slaughter calves also apply to the production of stockers.

Continuous growth and development is important in young animals whether they are to be used as replacement heifers or as fattening stock. Minimum requirements, as to forage quality, are considerably higher for young animals than for mature cows. Past experience seems to indicate that the quality of cane forage is not high enough during a large part of the year to maintain the rate of growth in weaned calves and yearlings that is usually considered desirable for proper development into breeding stock, or for most profitable production of feeder stock. This would suggest selling range calves at weaning time, or transferring stocker cattle to farms or improved pastures. As mentioned previously, however, pasture and cultivated land is quite limited in the principal cane areas. It is quite possible that range forage can be economically supplemented with concentrated feeds in order to meet the nutritional requirements of young animals. Moreover, there may be several advantages in raising herd replacements on the range: The supply of replacements would be assured, production costs may be below market price of comparable replacements, and it is thought that cattle raised on range do better than those not accustomed to such forage.

It seems, then, that problems involved in producing stocker cattle merit considerable attention in a range research program. They can conveniently be broken down into problems of "wintering" and "summering".

Wintering

The most critical part of the year for growing stocker cattle on range is the winter season. The nutritional value of cane forage decreases in winter and at this season cane forage alone cannot be expected to supply the quality of feed necessary for young growing animals.

Very little experimental work has been done in our area using native range for wintering stocker cattle and the feasibility of wintering young animals on cane range has not been established. Both at Wenona and the Hofmann Forest the weaned calves were moved off the range during the winter, except for two years work at Wenona where calves were fed two and four pounds of cottonseed meal daily while on open cane range. Those two years, calf gains on range were not as good as gains on pasture by comparable groups. The rate of gain was less than what is usually considered desirable for weaned calves.

The kinds and amounts of supplemental feed required, and methods and costs of supplementing need to be determined in order to evaluate the feasibility of wintering young stock on the range.

Summering

Summer gains of yearlings using switch cane forage alone have generally ranged between .60 and .90 pounds per head per day for the season at the Wenona area. This is from 30 to 50 percent less than gains normally expected from good improved pastures. Gains on yearling heifers at the Hofmann Forest generally were not quite so good as at Wenona. For some undetermined reason, it has not been unusual for yearling cattle on cane range to make little or no gain for a month or so in midsummer.

Stocker cattle produced in connection with a rotation grazing experiment at Wenona (5) did well in the feed lot and made gains quite comparable to those usually made by somewhat larger stocker cattle raised on pasture.

The indications are, then, that young stocker cattle can be produced on good range during the summer but that their rate of growth will be somewhat less than is desired. The economics of such production, needs to be clarified. Also, the practicability of improving summer gains with supplemental feeds seems to warrant investigations, particularly in connection with raising replacement heifers.

Production of fat market cattle

This phase of beef production is practiced to some extent by farmers making use of the native range for grazing, since corn is a cash crop in a large area of the Coastal Plain and, therefore, usually relatively cheap. Also, some farmers grow both cattle and corn and market the corn through cattle.

Three years work just completed at the Tidewater Station indicates that switch cane might be used to a limited extent as a roughage in the fattening program. Those farmers who have native range grazing in abundance may wish to fatten out some cattle if the native forage will do the job when supplemented with corn, or corn and protein concentrate. In view of the information at hand, however, research on this phase of range cattle production would seem to warrant low priority.

Mineral supplements

As stated elsewhere calcium and phosphorus are often deficient in native forage and it is considered good practice to provide both these minerals.

Some work has been done on the so-called trace elements in the Coastal Plain area of North Carolina and deficiencies are known to exist for certain agricultural crops. Whether or not deficienecies materially affecting cattle production are present has not been determined. However, work with cattle in Florida (24, 25) and the known deficiencies for crops in the Coastal Plain of North Carolina would indicate that the problem deserves study. The minor elements may explain some of the poor performance encountered in the areas of less abundant or less nutritious forage.

Herd management

In addition to the strictly nutritional problems there are problems of herd management which may be more or less closely associated with nutritional problems, but which are also important for other reasons.

Season of calving

Most commercial beef producers raising calves have their cows calve either in the early spring or fall. Each season possesses certain advantages and disadvantages under farm or ranch conditions. Under the forage conditions of the Coastal Plain, however, spring or late winter seem to be the most logical times for range calving. The problem arises as to just how early or late the calves should be dropped in the spring.

The common practice in previous research has been one of early calving, February and March in most instances. This way the cows were generally at the farm (at Wenona) or receiving supplement (at Hofmann Forest) when the calves were born and better attention could be given to cow and calf. Since the cows are not on good lush pastures and are generally wintered in only fair condition the cows apparently do not give milk up to their capacities during the first two or three months. It is thought by some that cows calving at about the time they went to summar range might get their calves off to a better start. This is a problem that should be given early consideration, since the production of slaughter calves is of primary importance in this area.

Age at calving

Studies have been conducted in the western range states to study the effect of age of breeding upon performance of the cow. Studies at Kansas (1919-20 Experiment Station Report) indicated that cows calving first as two year olds did not raise as large calves as cows calving first as three year olds and never fully recovered from the shock of the first calving regardless of feeding.

In the poorer Coastal Plain ranges the cows have been rather small to calve even at three years of age and while it would mean waiting a much longer time for cows to return anything on investment it might be best not to have the cow calve until four years of age. A more promising approach to the problem of small cow size, however, would seem to be through efforts to obtain better growth in the calf and yearling stage, and through selection of breeds or strains of cattle particularly adapted to Coastal Plain ranges.

Control and distribution of cattle

In large tracts of Coastal Plain forest land the control and distribution of the animals are definite problems in cattle and forage management. The two problems are closely related in that many of the factors and conditions involved are common to both.

Uniform distribution of grazing is important in the switch cane type to efficiently utilize the forage in accordance with good range and cattle management practices. There is a marked tendency for cattle to overgraze areas near concentration points, such as watering or salting places. Uniform utilization of a range is also often hindered by brush and briar thickets, and perhaps by dense stands of cane. From experience, particularly at Hofmann Forest, it has been found that distribution of cattle is facilitated by the presence of logging trails, roads, or even hunting trails. Also, grazing was more uniform in the areas where brush had been reduced by recent wildfires. Salting cattle at different locations or moving salt from one place to another has been used as a distribution method on western ranges, but the effectiveness of this use of salt in the switch cane type has not been investigated. The use of pasture firebreaks or fire lanes would seem to offer good possibilities for distributing cattle, especially if such lanes formed a network over the range.

In addition to the distribution problem some control over the cattle must be maintained for such purposes as checking on numbers and condition, treating injuries, moving the herd from one range to another, weighing, etc. Effective control is particularly important in the cane type where the vegetation may completely obscure the cattle, and where the use of horses is precluded by the density and height of cane and brush, the frequent occurrence of briars, and the precarious footing.

It has been found that limited amounts of feeding with palatable concentrates such as corn or cottonseed meal can be very helpful in training cattle to come to the herdsman when called. This practice was used quite successfully at Wenona. Control would logically be expected to be much better where the cattle were in relatively small pastures and where the herdsman was able to see and work with the cattle frequently. Roads and trails are very helpful in control as the cattle tend to follow them rather than break through dense vegetation.

More factual information is needed in order to judge the effectiveness and value of possible management practices for controlling range cattle and obtaining proper distribution of grazing. Observations and experiences suggest that the following practices, separately or in combination, merit consideration: 1) Use of ranges small enough to permit finding cattle easily, 2) feeding limited amounts of concentrates at frequent intervals, 3) providing access trails and perhaps open strips such as pasture firebreaks, and 4) proper distribution of water and salt.

Breeding for better performance

Investigations at the North Carolina stations as well as those conducted at other stations have shown that better breeding methods may be effective in producing more beef. Foster, Hostetler, and Case (10) report calves sired by a purebred Hereford bull averaged 386 pounds at weaning as compared to calves averaging 332 pounds sired by a native bull. All calves were out of native cows. Rhoad, Phillips and Dawson (27) reported significant differences between sires of different breeds as measured by weight of calf at six months. C. T. Bray of Louisiana State University reported in a personal communication that over a four year period calves sired by a Brahman bull made 16.3 percent more growth up to weaning age than calves sired by Hereford and Angus bulls.

From observations and experience many farmers and cattlemen have noticed that the so-called "native" cattle seem to thrive better than the high grades of the English breeds which were brought into the range area. Even though the natives lack the scale and conformation desired in beef production, their hardiness and milk production might make them of considerable value in a breeding program.

The extensive use being made of the Bos indicus species of cattle principally Brahman, in the South, especially in Texas, Louisiana, and Florida, had focused attention upon their possible use in the Coastal Plain of North Carolina. The present studies with these and other desirable breeds should be continued and every effort made to find that breed or strain of cattle best suited to beef production for this area.

THE PLACE FOR GRAZING IN FOREST MANAGEMENT

It is generally assumed that a full stand of trees will yield highest returns from the forest lands of the Coastal Plain and that grazing values are of secondary importance. We have no conclusive data to substantiate or refute this premise because the timber production potentialities have not been determined for the sites where grazing has been studied. However, from hypothetical comparisons discussed in a later section of this report ("Income from cattle") it appears that forage values might compare favorably with timber values on switch cane sites. The question of priority of use needs to be answered, but it will depend somewhat on the solution of problems of cattle and forage management.

A more urgent question would seem to be: are grazing and timber production compatible kinds of multiple land use? The indications are that grazing and timber production go well together in pine types and that grazing can be used to advantage in a land use program aimed at maximum forest production. To fully evaluate grazing in relation to forest management, several angles must be considered. Besides income or profit, these include effects on fire hazards, tree establishment, survival and growth, and possibly soil factors. Although problems related to beef production have received most emphasis to date, enough information has been obtained on the other aspects mentioned (except soil factors) to indicate some of the possibilities and problems involved.

Forest regeneration

Seedling establishment and growth were definitely encouraged by grazing in pond pine stands at Hofmann Forest. Five to six times more seedlings appeared on grazed plots than on ungrazed plots in unburned areas, and the growth rates of seedlings less than three feet tall were 7 to 67 percent higher on the grazed plots. Disturbance of the surface litter by grazing animals probably increased the chances for pine seed to reach a suitable environment for germination and establishment, and the removal of competing herbage undoubtedly accounts for the increased growth. Growth response was greatest for seedlings between 6 and 12 inches tall and no effect was apparent on seedlings over three feet tall, although numbers in the experimental sample were very limited in the taller height classes. It seems logical, however, that grazing would have progressively less effect on seedlings as they become larger and overtop competing vegetation. The principal source of competition materially influenced by grazing was switch cane which, in this case, was about three feet tall. Cane, however, made up less than one-third of the understory vegetation. The effect of grazing might be much more pronounced where cane or other palatable herbage accounted for most of the competition to pine seedlings, particularly in dense tall canebrakes.

Even though grazing encourages seedling establishment, burning seems to be eseential for successful regeneration of pond pine. In areas unburned for at least six years at Hofmann Forest, the average annual rate of establishment was less than 10 seedlings per acre without grazing, and only slightly over 50 per acre with grazing. Establishment was not significantly increased by logging. Following a wild fire in 1941 and two in 1945, however, seedling establishment was fairly abundant. Observations from these three fires indicate that burning effectively increases seedling establishment for at least three years although the greatest effect occurs during the first year. Also, hot fires are most effective: A relatively cool fire in February 1945 produced about 600 seedlings per acre in two years, while a very intense fire in April of the same year accounted for a total of 4000seedlings per acre during 1945 and 1946 (table 4). In the latter case, grazing apparently reduced the effectiveness of fire by decreasing its intensity, as indicated by more vegetation and surface litter remaining on grazed plots and about 40 percent fewer subsequent seedlings.

Table 4.--Establishment of pond pine seedlings (Average number per acre) on grazed and ungrazed plots at Hofmann Forest before and after two wild fires in 1945, compared to establishment on unburned areas

	Ungrazed plots			Grazed plots		
	1944	1945	1946	1944	1945	1946
Unburned 1/	20	4	12	28	28	76
Burned Feb.1945 2/	67	267	333	33	367	300
Burned April 1945 3/	0	2250	1700	150	1675	775

1/ A few of these plots were burned in 1941; the remainder were last burned in 1936.
2/ A relatively cool fire.
3/ A very hot fire.

The mortality of pine seedlings less than a foot tall averaged about 12 percent higher on grazed plots than on protected plots at Hofmann Forest. Larger seedlings were not affected appreciably although there was a slight indication that mortality among these might be decreased by grazing. Trampling was probably responsible for the increased mortality under grazing. Browsing damage was seldom observed.

Planting will be necessary to establish an adequate forest stand in many cane areas where fires have eliminated seed trees, or where it is desirable to convert from pond pine to some other species such as loblolly pine. In such cases grazing should be valuable for site preparation and fire control.

In summary, the available evidence indicates that grazing can benefit the establishment and growth of pine seedlings but it can also contribute to their mortality. The amount of benefit or damage under different circumstances needs further investigation and more information is needed on the silviculture of pond pine. It should be possible to adjust the grazing so as to maximize its advantages and minimize its disadvantages during the regeneration phase of forest management.

Fire protection

Wildfire is undoubtedly the major forest hazard of the Coastal Plain region. During the 1937 forest survey, almost 100 percent of the pond pine hardwood type showed evidence of burning, and on 1/4 to 1/3 of its area fire had been severe enough to kill saw-timber trees (9). Although the damage was less severe in other types, almost 80 percent of all forest land in the Coastal Plain had been burned recently enough that the

evidence of fire still remained. Fire conditions have improved only slightly in recent years and many areas, particularly in the Tidewater section, continue to burn periodically. Fire control is difficult because of the expense and limited accessibility of forest tracts with few fire barriers. The prolific understory of brush, cane, and other herbage characteristic of Coastal Plain forests produces intense fires which are difficult and dangerous to combat. Wet conditions which ordinarily prevail over much of the year add to the difficulty and expense of maintaining an adequate system of firebreaks in preparation for the occasional dry periods of high fire hazard. Under such circumstances grazing offers considerable promise as a presuppression measure in an effective fire control program.

Direct tests of the effect of grazing on fire behavior have never been attempted in North Carolina but general observations and fuel measurements indicate that grazing can effectively reduce fire hazards. Definite benefits of grazing were demonstrated on three recent occasions at Hofmann Forest when wildfires died out or were brought under control upon entering the experimental ranges. Fuel samples taken in these ranges after the first summer of grazing (1943) showed that there was only half as much fuel in the understory and on the forest floor in heavily grazed areas as there was in areas protected from grazing. After four years, there was 30 percent less total vegetation, and 50 percent less of the palatable species, on the grazed areas. Fuel reduction under moderate grazing was not determined at Hofmann Forest.

Fragmentary data from winter ranges at Hofmann Forest indicates that heavy winter utilization in the cane type can reduce the total fuel at least 50 percent, and keep inflammable material near the ground, without materially affecting forage yields of cane.

In the dense canebrakes at Wenona, reduction of total fuel was in direct proportion to the degree of utilization. After three years of continuous summer grazing, ranges heavily utilized (over 90 percent) had only four tons of fuel per acre as compared to 14 tons per acre on ungrazed or lightly utilized (30 percent) ranges. The actual fire hazard was probably decreased even more than is indicated by the reduction in total fuel because the continuity of the highly inflammable surface litter was broken up by trails and the less inflammable standing cane was thinned out to the point where it is doubtful that it would have carried fire even in a heavy wind.

The results cited above were obtained in instances where fire control was not of primary consideration. The efficiency of grazing as a fire control tool could undoubtedly be greatly increased if it were applied specifically for fire protection. This application warrants further study. One promising application which is now being investigated involves the cheap maintenance by cattle of wide fire lanes or "pasture firebreaks" established at strategic locations in the forest. In the cane type, concentrated grazing alone may provide effective fire protection. Prescribed burning would undoubtedly increase the protection by reducing fuel and concentrating grazing in strategic locations. Control of unpalatable brush in grazed firebreaks will also be a problem in many areas.

In view of the fire situation in the Coastal Plain, fire control might well be the most important benefit to be derived from grazing forest lands of this region. Efficient methods of applying grazing for this purpose, and tangible evaluation of the benefits obtainable, should be given full consideration in the grazing research program.

Income from cattle

Judging from experimental results obtained to date, forest grazing should be a profitable enterprise where good switch cane forage is available. The highly productive summer ranges at Wenona have produced approximately 125 pounds of gain per acre annually on a sustained yield basis, and up to 160 pounds per acre for a few years with overgrazing. Considering that no feed except salt and minerals were supplied during the seven-month summer grazing period there is no apparent reason for such performance not being profitable with reasonably good herd management. At current prices of feeder and stocker cattle, 125 pounds of beef represents a gross income of $25 per acre. About $20 of this could be expected to be net profit if overhead costs were distributed over a herd of 100 to 200 head. No trees are now on this area to indicate its timber producing potential, but assuming a site index of 80, yield tables (International rule) for loblolly pine indicate 34,500 bd. ft. per acre at 60 years of age, or 575 bd. ft. per year. To equal the estimated $20 net profit from cattle, the timber would have to sell at $35 per thousand board feet on the stump. Current stumpage prices on comparable sites seem to be in the realm of $15 or $20. Pond Pine would be expected to produce not more than two-thirds as much as loblolly pine, on the basis of limited comparisons at Hofmann Forest by Prof. G. K. Slocum (Forestry Dept., N. C. State College).

On poorer range at Hofmann Forest, cattle gains on summer range have averaged around 20 pounds per acre, worth about $4 at current prices for stocker and feeder cattle. Of this amount about $2 could reasonably be expected to be profit. On the same site, an annual growth of around 200 bd. ft. of pond pine timber per acre, with a current stumpage value of about $3, could be expected under good management (according to Dr. C. M. Kaufman, Forestry Dept., N. C. State College).

These rough estimates indicate that profits from cattle might exceed those from trees on good cane sites. Also, grazing can provide an annual income whereas trees are usually harvested at infrequent intervals. In addition, an undetermined amount of fire protection insurance could reasonably be credited to the cattle. It is possible that cattle performance on poor sites such as at Hofmann Forest could be materially improved by altering the management system. For example, one operator in North Carolina has found it practical to provide improved forage on pasture firebreaks and supplemental pastures.

The economic aspects of forest grazing should perhaps be given more attention in our research program than they have yet received. Practical operators are primarily interested in net profits and can best understand results which are directly interpreted in terms of dollars and cents. There are some difficulties involved in this approach because certain effects related to fire control and tree reproduction cannot easily be evaluated. Cattle performance is quite tangible, however, and an attempt should be made to realistically evaluate forest grazing practices in terms of cattle profits, at least, and to establish relative values of forage and timber.

Integrating grazing and timber management

It is highly probable that a combination of cattle and timber production will yield greater returns than either use alone. Specific guides as to the most efficient integration cannot be formulated, however, until the interactions between forage production and timber stands are established, and the relative value of the two resources are determined. But after efficient methods of forage and cattle management are developed, it should be relatively easy to adapt them to situations where either grazing or timber is to be the primary use.

If maximum tree production is desired, it would seem that timber management need not be materially affected by incorporating grazing use because grazing apparently has little or no effect on trees beyond the seedling stage. On the other hand, trees may have a pronounced effect upon forage, and grazing management will probably be influenced by the timber management.

As mentioned previously, a tree canopy seems to be essential for good winter forage in the switch cane type particularly after December. Clear-cut or very open forest sites, therefore, are most useful for summer range, while timbered areas may be used at any season.

Forage production undoubtedly decreases as the timber stand density increases. The relationships between tree density and forage production have not been investigated but apparently the effect of pine trees on cane productivity is not as pronounced as might be expected. Cane is shade tolerant and maintains a fairly productive stand beneath a closed canopy of young pine. It has been observed, however, that after a closed stand of pine reaches pole size the cane thins out considerably. In a relatively open stand of mature pond pine at Hofmann Forest logging had no measurable effect on grazing capacity. In this case, however, brush competition apparently influenced forage production more than did the trees. At the present time, most pine stands associated with the switch cane type apparently are relatively open or very young (9).

It is probably safe to assume that changes in grazing capacity due to tree growth will be gradual. There should be no difficulty, therefore, in adjusting grazing as forest stands develop. It would be very helful in making long-time plans, however, if the general relationships between timber stand density and forage production were known. Also, the response of cane following removal of timber should be investigated further.

The most efficient use of grazing during the regeneration phase of forest management will depend upon the silvicultural requirements of the species involved. Silvicultural information on pond pine is extremely limited, but as pointed out previously a hot fire seems to be necessary to obtain effective seedling establishment and young seedlings grow rather slowly. Also, seedlings less than six inches tall are particularly vulnerable to trampling damage. Therefore, in order to regenerate pond pine in cane areas, taking full advantage of the beneficial aspects of grazing, some procedure involving the following features seems to warrant consideration: 1) heavy grazing preceeding logging to weaken the cane stand; 2) burning just prior to logging; 3) complete protection until seedlings are well established (perhaps two or three years); then, 4) moderately heavy grazing to encourage seedling growth and reduce fire hazards.

Cattle might be incorporated into a fire control system by providing for concentrations of grazing at strategic locations during critical seasons of the year. This could possibly be accomplished by fencing, burning, or introducing improved forage species. The most practical and effective methods of using grazing for this purpose should be determined. Establishing pasture firebreaks, where feasible, ought to improve cattle performance and aid in cattle management in addition to providing some fire protection.

To summarize, then, the incorporation of grazing into a forestry program need not complicate timber management. Only minor adjustments in the management system seem to be necessary to take full advantage of the potential benefits of grazing. The details of these adjustments need to be worked out, and their value demonstrated, on an experimental basis. Much more needs to be known concerning the relationship between forage and timber values, and the effects of trees on forage production, before the most profitable integration can be formulated.

SUMMARY OF RESEARCH PROBLEMS

As indicated by the foregoing analysis, many problems pertaining to forest grazing have not yet been attacked in the research program and others have been only partially solved. Questions which should be answered in order to manage grazing efficiently, and to determine its proper place in a sound land use program in the switch cane forage type, are listed below. The list is not considered to be complete but it includes questions clearly recognized by the authors at the present time. Priority ratings represent the authors' judgment of the relative importance of the problems involved or the urgency for information in the orderly development of a research program.

A. Forage Management

1. Grazing capacity

What is the general carrying capacity of switch cane range and how is it related to recognizable variations in site quality? (Priority medium. Some information available.)

What are the general relationships between timber stand and grazing capacity? (Priority high. Some leads obtainable from current studies.)

How does carrying capacity vary among seasons and between years? (Priority high. Preliminary study begun.)

2. Degree of utilization

a. For sustained forage yield

What is the maximum degree of utilization permissable at various seasons, or growth stages, and under different systems of grazing management? (Priority high. Current studies providing preliminary information on seasonal aspect.) Does site quality, or cane size, influence the proper degree of utilization? (Priority high. Limited preliminary information available.)

b. For other purposes

What degree and season of utilization will most effectively cut down the height or density of the cane stand in order to encourage tree reproduction or reduce fire hazards? (Priority medium. Preliminary information provided by current studies.)

3. Management systems

What systems of management will produce most cattle gains, maintain high forage productivity, and be easy for a farmer or cattleman to apply? (Priority high.)

How can cane range be managed most effectively in conjunction with other native forage types or farm pastures and crops? (Priority medium. Some information available.)

4. Techniques

How can gross carrying capacity, or total amount of forage, be measured or estimated with reasonable accuracy by a) research technicians and b) farmers or cattlemen? (Priority high. Studies underway.)

What are the most efficient methods or procedures for determining degree of utilization of cane foliage? (Priority high. No work done on techniques.)

What experimental techniques are most efficient for evaluating forage response to management practices? (Priority high.)

What early indications of deterioration of the forage stand can a practical operator use to detect mismanagement before the forage stand has been damaged seriously, i. e., what are the indicators of condition and trend? (Priority high. Leads provided by current studies.)

5. Cultural treatments

Will fertilization or drainage materially affect the quality or quantity of cane forage? (Priority low.)

What are the possibilities for increasing carrying capacity or cattle performance, particularly during winter and early spring, by introducing improved forage species? (Priority medium.)

Is it feasible to artificially establish cane on adapted sites or re-establish stands destroyed by fire or grazing? (Priority low.)

Are brush control measures such as burning, mechanical chopping, or chemical sprays feasible or practical on brushy range? (Priority medium. No work done.)

6. Ecology

What are the fertility and moisture requirements and tolerances of cane? (Priority medium.)

What is the relationship between soil fertility and the chemical composition of cane foliage? (Priority medium.)

What is the value of cane as an indicator of site quality? (Priority low.)

How is the competitive position of cane influenced by fire? (Priority medium.)

What is the life cycle of cane; what factors affect or control flowering and seed production? (Priority low.)

6. Poisonous plants

What is the economic importance of cattle losses due to poisonous plants? (Priority medium.)

What is the general distribution, abundance, toxic property, danger period, and method of control for the species of poisonous plants in the region? (Priority low.)

B. Cattle management

1. Economic aspects

Under what conditions is a range cattle operation profitable in the switch cane forage type? (Priority high. Will be answered by accumulated data from separate related investigations.)

What are the relative profits in the production of slaughter calves and stocker cattle? (Priority medium. Few cost figures available.)

2. Managing the breeding herd

a. Age at calving

What effect has age of first calving upon calf produced and future performance of range cows? (Priority medium. Very little information available for this type range.)

b. Season of calving

What is the optimum calving season for the Coastal Plain range conditions? (Priority high. Some leads obtained in previous work.)

c. Wintering the cow herd

What conditions of forest cover and kinds of forage and browse species are suitable for winter range? (Priority medium. This question partially answered.)

How is the level of nutrition of the cow herd in winter related to percentage conception and calf performance the following summer, and what kinds and amounts of supplemental feed should be provided cows on winter range? (Priority high. Some information available from Wenona and Hofmann Forest.)

d. Summer grazing

What are the effects of different forage management systems on cattle performance? (Priority medium. Some information available.)

What effect has summer gain upon the amount of supplemental winter feed required? (Priority medium.)

Is it practical and economical to provide supplemental concentrate feed for the cow herd during the summer? (Priority medium.)

Under what conditions is creep feeding of range calves profitable? (Priority medium. Some information available.)

How much do flies and external parasites influence the performance of range cattle and what control measures are practical? (Priority medium.)

e. Mineral supplement

To what extent are mineral deficiencies present and how may they be corrected? (Priority medium. Some leads have been obtained in a previous study.)

3. Wintering stocker cattle.

Is it practical to winter weaned calves and yearling cattle on the range? (Priority high.)

What kinds and amounts of supplemental feeds are required by weaned calves and yearling cattle on winter range? (Priority high.)

What use may be made of improved forage species for supplementing native range in the winter? (Priority medium.)

4. Breed improvement

What breeds of cattle and breeding programs are most suitable for beef production under Coastal Plain range conditions? (Priority medium. Investigation underway.)

How can the "native" cattle found in the area be used effectively in an improvement program? (Priority low. Some information available.)

C. Integration of grazing and forest management

1. Fire protection

How much are fire hazards reduced by systems of grazing designed to maintain maximum yields? (Priority high. Data available only for continuous summer grazing.)

How should grazing be managed for maximum reduction of fire hazards? (Priority high.)

Can prescribed burning in combination with grazing be used effectively to reduce fire hazards? (Priority high. Limited information obtainable from one preliminary trial.)

Can effective pasture firebreaks be established and maintained economically in Coastal Plain forests? (Priority high. Study begun.)

What forage species and cultural practices are useful for establishing pasture firebreaks on switch cane sites? (Priority high. Study underway.)

2. Pine regeneration

How can burning and grazing be applied most effectively to secure adequate seedling establishment of pond pine? (Priority medium. Preliminary leads obtained at Hofmann Forest.)

How can grazing be applied to effectively increase the growth rate of pine seedlings without materially increasing seedling mortality? (Priority medium. Leads obtained at Hofmann Forest.)

Does grazing have any effect on trees beyond the seedling stage? (Priority high.)

Does grazing have any value for controlling undesirable hardwoods? (Priority low.)

3. Supplementary income

What is the economic value of grazing use, and how much consideration do grazing values warrant in forest management plans? (Priority high.)

Which silvicultural systems or cultural practices will maintain highest grazing values? (Priority medium)

4. Miscellaneous influences

How does grazing affect forest soils? (Priority medium.) How does grazing influence wildlife, particularly deer? (Priority low.)

THE RESEARCH PROGRAM

Limitations of manpower, finances, cattle, land, equipment, and other facilities will necessarily dictate the extent of the research program. Relatively few problems can be undertaken at one time. High priority problems will receive first attention insofar as facilities and conditions permit. Wherever possible, individual studies will be designed so that they will yield information on several problems at the same time. Some important questions will not require special projects but can be answered from cumulative data from studies of related problems.

Certain problems, particularly those pertaining to cattle management, require expensive studies involving herd-size range pastures. Others can be studied efficiently on a smaller scale employing plots or "miniature pastures". This latter group could include some of the forage management problems and perhaps those involving the integration of grazing and forest management. Promising procedures or practices worked out on a plot basis, however, should be tested and demonstrated on a realistic or practical scale.

Current studies

At the present time, three major studies are active, two more are in the final stages of completion, and four have been completed in the field and are being analyzed and summarized for publication.

The active studies include a long-term cattle breeding investigation (subproject No. 8) started at Hofmann Forest and now transferred at the Frying Pan Range; an investigation of methods and species useful for establishing pasture firebreaks (Subproject No. 11) which is being conducted at Tidewater Station and at the Drying Pan Range: and a forage study involving methods of determining grazing capacity of switch cane and effects of heavy utilization at various seasons (Subproject No. 12) at Tidewater Station.

The field work on two plot studies, conducted at Hofmann Forest was finished last spring but final data involving chemical analysis have not been completed. They are concerned with effects of degree and season of defoliation on the productivity and vigor of cane (Subproject No. 9), and organic food reserves of cane in relation to season and stage of growth (subproject No. 10).

Closed out studies in the process of being analyzed and summarized include grazing rates (Subproject No. 1) at Wenona, finishing steers on range (Subproject No. 2) at Wenona and Tidewater Station, wintering breeding cows (Subproject No. 5) at Hofmann Forest, and relative grazing values and nutritive properties of native forage species (Subproject No. 7) at Wenona and Hofmann Forest. Portions of the data from subproject 5 and 7 have already been published.

Subproject No. 3, "Logging Effects and Degree of Grazing" at Hofmann Forest, has been analyzed and written up as an office report but not published.

Experimental Areas

The Frying Pan Experimental Range provides a very good work center for large and small scale studies. The 2500-acre tract includes about 1800 acres of good switch cane range in a pond pine forest having various tree stand conditions. Located in Tyrrell County near the heart of the most extensive canebrakes remaining in the country, the site appears to have an average grazing capacity of 1.1 to 1.5 cow months per acre in summer, which is intermediate between the exceptionally high quality range at the former Wenona work center and the low quality range at Hofmann Forest. Boundary fences, corrals and weighing facilities, have been installed. A total of 20 separate ranges, mostly 70 to 85 acres in size, have been laid out. Fifteen of these have been fenced and the remainder will probably be completed by July 1950. Additional grazing areas are provided by fenced "protective strips" which have been established along the west and north boundaries and between the two south tiers of ranges, and also by strips of cane lying between the east fence line and a deep swamp. This set-up should be adequate for a breeding herd of 60 to 75 cows and an equal number of young replacement stock. The most serious obstacle is the soft soil which is not suitable for truck or car travel, and requires the use of a "crawler" tractor and a sled for transporting feed and supplies.

Although small scale studies are now being conducted at Tidewater Experimental Station, the range areas there are scheduled for development into improved pastures within a few years.

The immediate program

Problems selected

Until sufficient information has been obtained to guide cattlemen and landowners in a successful range cattle operation, the practical problems of range and cattle management doubtless deserve main attention. From this viewpoint, the problems listed below are thought to be most urgent and will receive primary consideration in the research program. They are arbitrarily classified under three major categories or aspects of forest grazing in the cane forage type.

I. Range Management

a. Determining grazing capacity.

b. Determining proper degree of utilization.

c. Determining efficient grazing systems.

d. Developing efficient techniques for range appraisal, including grazing capacity, utilization, and condition and trend.

II. Cattle Management

a. Determining herd management practices which will yield profitable calf crops.

1. Determining optimum calving season.

2. Relating forage and supplemental feeding practices in winter to subsequent cow productivity.

b. Determining efficient procedures for raising herd replacements and stocker cattle.

1. Determining the feasibility of wintering weaned calves and yearlings on range.

2. Determining procedures for assuring adequate growth and development of young cattle on summer range.

c. Determining the conditions necessary for a profitable range cattle operation.

1. Relate range conditions and management practices to expected profits.

III. Integrating grazing and forest land management

a. Determining how grazing can be employed most effectively to reduce fire hazards, and to encourage pine reproduction.

Experimental approach

We propose to attack these problems as follows during the next three to five years:

I. Range Management

Subproject 12 (at Tidewater Station) will be continued through its third year (1951), or longer if necessary, to develop reliable procedures for estimating grazing capacity and determine periods of the year when cane is particularly vulnerable to over-use. For the latter purpose, the study will be intensified somewhat by measuring food reserves of the cane stands during the third year.

A new study (No. 13, described later) will be installed at the Frying Pan work center to develop improved systems of grazing management, investigate proper degree of utilization, measure grazing capacity, and check the reliability of range appraisal techniques developed at Tidewater Station.

II. Cattle Management

Study No. 13 will yield information on optimum calving dates and the winter supplemental feed requirements of range cows, as well as herd performance under different grazing systems. In addition, information will be obtained on the performance of cows of three lines of breeding.

Another new study (No. 14, described later) will be installed at the Frying Pan work center to investigate the feasibility of wintering weaned calves and yearlings on range, and the practicability of supplemental feeding of young animals on summer range to produce better replacement stock and market animals.

Complete records will be kept of the range herds and all phases of the studies to permit economic evaluations of management practices and of a range cattle enterprise in cane-type forest range.

III. Integrating grazing and forest land management

With the personnel and facilities now available to the project, comprehensive studies of the fire problem will not be possible in the foreseeable future. Nevertheless, an effort will be made to obtain some evaluation of the effects of grazing on fire hazards, and to provide opportunities for additional future studies. In Study No. 13, light fuel and forest litter will be measured on grazed and ungrazed plots, to obtain an indication of fire hazard reduction under different intensities of grazing and systems of management.

A preliminary study of pasture firebreaks (Subproject 11) at Tidewater Station, and a supplement at Frying Pan, will be continued through 1951. If this special application of grazing to the fire problem shows promise, it will be investigated further as conditions and facilities permit.

Responses of pine seedlings to grazing will be investigated to a limited extent by measuring seedling establishment and growth on grazed and ungrazed forage plots in Study 13. However, the Frying Pan work center offers considerable opportunity for studying regeneration and other phases of pond pine silviculture and management in relation to grazing, if such studies are desired and facilities become available.

NEW STUDIES

Two major studies, involving considerable investment in fencing, cattle, labor, and technical effort, are planned for installation at the Frying Pan Experimental Range during 1950-51. The Main aspects of these proposed studies are described briefly in the following pages. Detailed working plans are being prepared separately.

Study No. 13

Management of Cane-Type Forest Range:

Deferred-Rotation vs. Continuous Grazing

Purpose and objectives:

This study is expected to yield information on urgent problems, discussed in the preceding analysis, related to both forage and cattle management. Specifically, it is intended to give information on: 1) "improved" systems of grazing management in comparison to the standard system of continuous grazing, 2) the supplemental feed requirements of breeding cows on winter range, 3) grazing capacity and proper degree of utilization of cane range, and some relationships between forest stand and grazing capacity. Also, it will provide an opportunity for measuring influences of grazing on such factors as fire hazards and tree reproduction.

Major range treatments and comparisons:

Continuous grazing will be compared with deferred-rotation grazing. Under continuous grazing, summer and winter range will be separate. Under the other system, grazing on a particular range will begin with the winter season and continue on through the following summer; then this range will be rested through the next winter and summer. Thus, grazing will be deferred throughout the growing season on alternate years, but the forage produced during the deferred season will not be wasted.

Stocking will be adjusted to obtain an average of approximately 70 percent utilization of cane foliage at the end of the summer grazing period (December). Undoubtedly some portions of the ranges will be utilized more than this amount and other portions less. It is anticipated, therefore, that there will be an opportunity to observe and measure forage responses to summer utilization ranging from perhaps 40 percent to 90 percent. In winter, the maximum degree of use commensurate with satisfactory cattle performance will be tolerated, i. e., the cows will be removed only if there is insufficient forage to satisfy their needs. Here, also, there will be an opportunity to observe different degrees of utilization within each grazing system.

The two management systems will be evaluated by sustained grazing capacity (in cow days) and cattle performance, and by forage responses measured on small plots.

Supplementary range treatments and forage comparisons:

An additional grazing system will be investigated on a plot or "miniature pasture" basis, and evaluated only by forage responses. This will be deferred-rotation grazing of summer range where grazing will be deferred until mid-season on alternate years, i. e., a particular unit of summer range will be grazed from May until August one year, and from September until December the next. The degree of utilization will be approximately 70 percent. This system differs from the previous "rotation" system tried at Wenona in two respects. First, the grazing here will actually be rotated between early and late use, whereas at Wenona a range was grazed either late or early and not rotationally in the usual sense of the word. Secondly, utilization will be heavier and at a level where differential responses can be expected to develop between systems if their effects on a forage stand are appreciably different.

This supplementary comparison will be obtained by constructing two enclosures (approximately 1/2 acre in size) in each of the continuous summer-grazing ranges. One of the enclosures will be opened to the cattle only during the first part of the season, and the other will be opened only during the last part of the season. In order to assure obtaining the desired degree of grazing, these enclosures will be located near the watering places. Over-use will be prevented by closing the gates whenever necessary.

A third enclosure, paired with the two already mentioned, will be grazed continuously at an intensity which will result in 70 percent utilization at the end of the season (similar to the average of the major range units.)

Four non-grazed enclosures (approximately 1/10 acre each) will be distributed in each of the eight ranges. These enclosures will provide permanently protected areas of range with which to compare the various grazing intensities and systems of management. Forage stand will be inventoried periodically on permanent plots in these enclosures and on comparable grazed areas.

Miscellaneous forest aspects:

Pine reproduction will be studied on a limited scale by recording establishment and growth of pine seedlings on grazed and protected plots (two each) at each of the enclosures.

The effect of the grazing treatments on fire hazard will be investigated at these same enclosures by measuring or estimating readily combustible litter and light fuel. This phase, however, can be delayed if necessary until the third or fourth year of grazing treatment.

Cattle treatments and comparisons:

The cows will be treated uniformly except for the systems of grazing. The herds will be made up of Brahman-Hereford crossbreds, Africander-Hereford crossbreds, and grade Herefords, permitting an evaluation of these three lines of breeding. During the winter grazing season (January through April), all herds will be fed protein supplent (cottonseed meal). The rate of supplemental feeding will be varied as necessary to maintain a thrifty condition of the cows, beginning with one or two pounds per head daily and increasing to four or six pounds as the season advances.

The question of optimum calving season for range herds will be studied by keeping records on every calf and relating gains and development to birth date. The breeding season will be extended over a full three months so that calves can be expected to be dropped from late February through May. The calves will be weaned when they are six to eight months old.

Physical facilities:

The experimental layout will consist of eight ranges, numbers 13 to 20 inclusive, already established at the southern end of the Frying Pan work center (see attached diagram). The ranges are 60 to 85 acres in size and fall in two tiers; those in the north tier (Nos. 13-16) are more heavily forested and are 5 to 15 acres larger than those in the south tier (Nos. 17-20). Each tier will contain one replication of the range management system. The ranges appear to be reasonably comparable in grazing capacity.

The same system of grazing management will be applied to four additional ranges (Nos. 9 to 12) which will be used as "overflow" or "holding" ranges to take care of replacement and surplus cattle. This will allow for adjustments of herd sizes to conform to grazing capacity of individual ranges and, essentially, it will provide an additional replication of the management system.

Sixty to 75 cows will be used in the study.

Duration:

The study should run at least four years, which would go through two cycles of the deferred-rotation grazing systems.

Status:

All eight range pastures, (as well as the "overflow" ranges) have been installed. Also the 32 ungrazed enclosures, the "miniature ranges", and 128 permanent forage plots have been established.

The herds have been managed according to the proposed plan since January 1950.

Study No. 14

Cattle Management on Cane Range:

Supplemental Feeding of Calves and Yearlings

Purpose and objectives:

This study deals with the problem of raising replacement heifers in range operations having no improved pasture. It will investigate the practicability of supplementing range forage with concentrated feeds to obtain better growth of the cattle from the time they are young calves until they are put into the breeding herd at two years of age.

The overall study will include four phases corresponding to the following stages of growth and grazing seasons:

1) the first summer as nursing calves,

2) the first winter as weaned calves,

3) the second summer as yearling heifers,

4) the second winter as long yearling heifers.

Treatments and comparisons

I. Creep Feeding of Calves: Supplemented vs. unsupplemented.

In two of the four herds of Study No. 13 the calves will have free access to a mixture of concentrates fed in a creep. The other two herds will not be creep fed. The creep feeding treatment will be alternated between replications of the herd treatment each year. The treatment will be evaluated on the basis of calf gains in relation to feeding costs from the viewpoint of producing both slaughter calves and stocker cattle.

II. Wintering Weaned Calves and Yearling Heifers:

Three levels of supplementing with cottonseed meal will be used: for calves, 1, 3, and 5 pounds per head daily; for heifers, 2, 4, and 6 pounds. The wintering period will run from December through April.

Calves and heifers will be kept separate, with three groups of each. There will be six to ten head per group, depending on calf crops obtained from the breeding herds.

Ranges No. 3, No. 4, and No. 5 will be divided by cross-fences into six approximately square ranges of about 40 acres each for this study. These ranges have been selected because, having firm ground at the south end, they are particularly suitable for feeding at both ends. Range No. 2 can also be used if additional range seems advisable.

Treatments will be evaluated primarily by rate of gain in relation to minimum acceptable growth rates for proper development of breeding stock.

III. Supplementing Yearling Heifers on Summer Range:

The initial comparison will be supplemented vs. unsupplemented; the supplement consisting of one or two pounds of cottonseed meal per head daily. After two years the study may be expanded to include different rates of supplementing.

Initially this study will involve only two groups of 9 to 15 head each, depending on the number of animals available. The groups will graze ranges No. 6 and No. 7, and will be alternated between these two ranges each month to minimize possible effects of range variability.

Here again, treatments will be evaluated in terms of cattle gains; primarily from the viewpoint of proper development into breeding cows, but also for stocker cattle.

Forage and forest phases:

Due to limited personnel, no detailed studies of forage and forest aspects will be undertaken in this subproject.

An initial forage survey will be made of each range. Also, at least two fenced enclosures, together with fenced and grazed forage plots, will be established in each range prior to grazing. These plots and enclosures will provide a basis for detecting any appreciable vegetational changes.

The degree of forage utilization will be estimated periodically while the ranges are being grazed. The aim is to provide sufficient forage to prevent heavy grazing. If the average utilization of summer ranges (Nos. 6 and 7) reaches 60 percent before the end of the grazing season, the heifers will be moved to a new range.

Initiation:

The study will be started during 1950; treatments I and III in the spring, and treatment II at the beginning of the winter season.

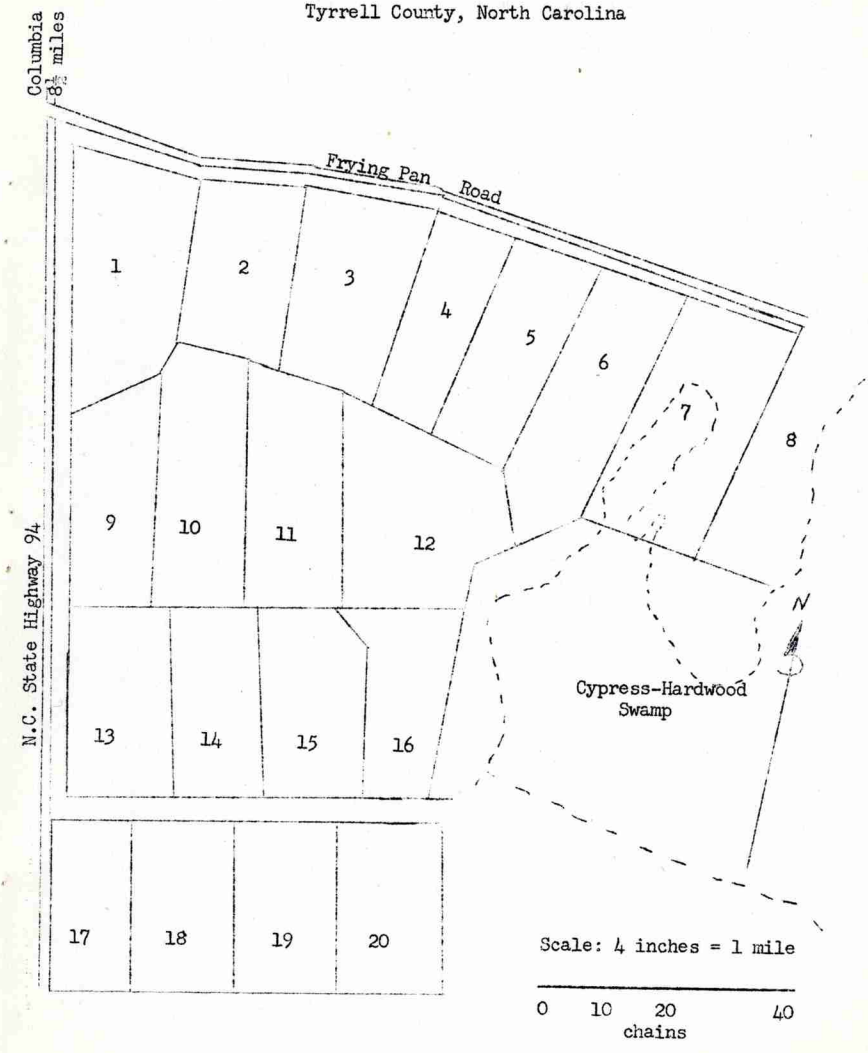
Duration:

The study will run for four years or until definite results have been obtained. Records of the individual animals will be kept so that their performance can be followed for a year or two after treatments.

RESPONSIBILITY

W. O. Shepherd will be directly responsible for the technical supervision of the forage and forestry phases, and E. U. Dillard for the animal husbandry phases. R. H. Hughes will be immediately responsible for field work pertaining to the forage and forestry phases. General supervision and administration of the project will be under E. H. Hostetler (Representing North Carolina State College, and U. S. Bureau of Animal Industry) and R. D. McCulley (U. S. Forest Service, Southeastern Forest Experiment Station). Major changes in the program and publications will be considered and approved by the directors and heads of the divisions of the various cooperating agencies.

FRYING PAN EXPERIMENTAL RANGE
Tyrrell County, North Carolina



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RESEARCH PROGRAM
Range Study No. 14 (NCP #36)

FOREST GRAZING STUDIES IN THE COASTAL PLAIN OF NORTH CAROLINA

Working Plan

(Study No. 14)

CATTLE MANAGEMENT ON CANE RANGE:

SUPPLEMENTAL FEEDING OF CALVES AND YEARLINGS

Prepared by
W. O. Shepherd and E. U. Dillard
June 1950

A cooperative project
of
The Agricultural Experiment Station
of the
North Carolina State College of Agriculture and Engineering
with
The North Carolina Department of Agriculture
and
The Forest Service and Bureau of Animal Industry
of the
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CATTLE MANAGEMENT ON CANE RANGE

Supplemental Feeding of Calves and Yearlings

(Study No. 14)

PURPOSE AND OBJECTIVES

This study is aimed primarily at the problem of raising herd replacements in a range cattle operation having no improved pasture or farm land.

It has application to the production of market animals on range.

Specifically, this study will investigate:

The practicability of supplementing suckling calves and yearling heifers during the summer grazing season.

The feasibility of wintering weaned calves and long yearlings on cane type forest range.

The adaptability of certain cattle breeding lines to the conditions found in Coastal Plain range areas.

THE PROBLEM AND ITS IMPORTANCE

Continuous growth and development during the first two years of a cow's life is highly important to her future size, breeding performance, sale price, and overall value in a breeding herd. Therefore, efficient production of herd replacements can be a deciding factor to the success of a beef cattle operation. This would appear to be the case in our Coastal Plain range areas where forage quality, though satisfactory for mature cows, does not seem to be adequate during a large part of the year to maintain the rate of growth desired in young animals. Possibilities for increasing growth rates economically may also influence the type of operation to be recommended, as well as the profits realized.

The desired level of nutrition can be supplied, of course, by tame pasture, field crops, or harvested feeds in cases where range can be used in connection with a farming operation. But much of the best range in North Carolina occurs in areas having limited farm land, or in locations relatively inaccessible to farm land.

Also, herd replacements could be purchased from other regions, but in addition to the economic and health aspects of such a practice, there are reasons to believe that range production may be preferable. For one thing, it is thought that cattle raised on native range do better than those not accustomed to such forage.

Possibilities for obtaining better development of young range cattle, whether they be used as herd replacements or market stock, have an important bearing on any range cattle enterprise in the Coastal Plain region. But developing and demonstrating a practical system of operating a profitable beef cattle enterprise based entirely, or primarily, on native range might have even greater implications in the tidewater section where hundreds of thousands of acres of good forage is now only contributing to forest fire hazards. The expansion of a range cattle industry in this region of limited farm land would benefit not only the landowner through an increased income and reduced fire hazard, but also local communities and counties through an increased wage and tax base.

SCOPE

This study will explore the feasibility of supplementing native cane forage with concentrated feed as a means of obtaining better growth of range cattle from the time they are young calves until they are put into the breeding herd at two years of age.

The study will include four phases corresponding to successive stages of development in relation to arbitrary management practices and grazing seasons:

1) the first summer as nursing calves,

2) the first winter as weaned calves,

3) the second summer as yearlings,

4) the second winter as long yearlings.

The wintering of weaned calves and long yearlings is described later as a single phase.

Cottonseed meal will be used as the supplemental feed except for the nursing calves which will be fed a mixture of meal and grain.

Cottonseed meal was selected because it is palatable and rich in protein and phosphorus (which are sometimes deficient in native forage), convenient to handle, readily obtainable, and relatively cheap. Also, its nutritive properties are well understood and replacement values of either concentrates can be readily calculated with reasonable reliability.

The only comparison to be made in summer will be supplemented vs. unsupplemented. Suckling calves will be fed "free choice" in a creep. Yearlings will be fed a daily rate of one pound per head during the early summer and two pounds late in the season if gains tend to fall off. If the results indicate that supplemental feeding in summer is worthwhile, further investigation of optimum rates may be desirable.

In winter, supplemental feeding is almost certain to be necessary or desirable. Therefore, the comparison will be between three levels of feeding. A fairly wide range in rates will be employed in order to find the approximate rates that appear to be required or desirable.

An economic appraisal of the results of this study will indicate whether or not raising herd replacements is practical on "average" cane range, such as occurs at the Frying Pan work center. Also, it may reveal possibilities for profitably increasing growth rates of young market animals and thus should provide a basis for determining the age and season at which they should be sold.

The experimental cattle will be of three lines of breeding: Brahman-Hereford crossbreds, Africander-Hereford crossbreds, and grade Herefords. Therefore, the study will also provide an evaluation of the performance of these three cattle populations on cane range and at different levels of nutrition.

PAST WORK

Creep feeding of suckling calves was studied for four years on high quality cane range at Wenona. Although gains of the creep-fed calves were higher near the end of the grazing season, the practice was not considered profitable for this range where calves weighed 375 to 400 pounds at weaning time without supplemental feed. On the other hand, a preliminary, one-season test indicated that creep feeding of suckling calves may be profitable at Hofmann Forest where the range was of lower quality and the calves usually weighed between 275 and 300 pounds when weaned.

Summer gains of yearlings grazing cane forage alone at Wenona have generally ranged between .6 and .9 pounds per head daily for the season, which is 30 to 50 percent less than gains usually expected from good improved pasture. Gains were somewhat lower at Hofmann Forest. In both areas gains have tended to fall off late in the season and, for some undetermined reason, yearling cattle often make little or no gain for a month or so in midsummer. Supplemental feeding of yearlings during the summer has not been tried on cane range, although yearling steers have been partially finished for market on range with a full feed of concentrates after August 1.

The winter season is the most critical part of the year for young range animals. Chemical analyses and cattle gains indicate that the quality of cane forage approaches, or falls below, the minimum requirements even for mature breeding cows from January through March, especially on the less productive sites, such as at Hofmann Forest.

In most previous studies at both Hofmann Forest and Wenona, the weaned calves and yearlings were taken off the range during the winter. The feasibility of wintering young animals on cane range was not investigated except for two trials at Wenona. There, two groups of calves were wintered on open range supplemented with two and four pounds of cottonseed meal daily and compared with a third group

wintered on a farm. Although the groups on range gained less than the farm group, and somewhat less than is usually considered desirable for weaned calves, differences between the groups largely disappeared during the following summer when all calves grazed together on cane range.

As a rule, cane range is not a dependable source of winter forage unless it is protected by a tree canopy. In the open, most of the leaves usually drop off by February or March. The present study will apply only to forested cane range.

METHODS

CREEP FEEDING OF CALVES:

Herds and ranges:

The creep feeding treatment will be applied to the breeding herds on a grazing management study (Study No. 13) where the continuous grazing system is being compared with a deferred-rotation system with two replications plus an "overflow" herd under each system. Each herd includes Brahman-Hereford crossbreds, Africander-Hereford crossbreds, and grade Herefords.

Assignment of treatment in replications 1 and 2 will be such that one herd in each replication and each grading system will be creep-fed concurrently. Also, each herd will be alternately creep-fed and non-creep-fed in successive years. Thus, under the continuous grazing system, creep feeding will be alternated between ranges 13 and 17; under the deferred-rotation system, between ranges 15 and 18 or between 16 and 19. The initial assignment will be by chance.

Creep-feeding will be alternated between the two overflow herds each year.

Feed:

A mixture of cottonseed meal and grain will be available to the supplemented calves at all times in a creep constructed near the watering trough. Creep feeding will continue until the calves are weaned in November or December.

During the first two months of the breeding season (mid-May to mid-July), when the cattle will be regrouped according to breeds, all calves will be creep-fed.

WINTERING WEANED CALVES AND YEARLINGS

Supplemental feeding treatments.

Three levels of supplemental feeding with cottonseed meal will be used; low, medium, and high. For weaned calves the levels will be 1, 3, and 5 pounds per head daily. For yearlings they will be 2, 4, and 6 pounds.

The wintering period will begin in December and run through April.

Groups and ranges:

Calves and yearlings will be kept separate with one group of each on each supplement level. Thus, there will be three calf groups and three yearling groups, each on separate ranges. The groups will have 6 to 10 head each, depending on the calf crop.

Ranges 3, 4 and 5 have been divided into six comparable ranges of approximately 45 acres each for this study. The North and South halves will be used by calf groups one year and yearling groups the next.

In addition, the groups will be periodically rotated between their respective ranges so that each group will graze each of three ranges twice during one wintering period.

These ranges have a rather uniform stand of cane and pine trees (pole size), and are expected to supply ample forage for the cattle. However, another 85-acre range (No. 2) is available in case additional range is needed.

Calves

Weaned calves will come directly from the breeding herds of Study Number 13, and the creep-feeding phase of this experiment. Therefore, previous treatment and breeding will be taken into consideration in assigning calves to the three

wintering groups, i.e., each group will contain formerly creep-fed and non-creep-fed calves of each of the three breeding lines if possible. Each group, then, should preferably contain at least two of each breeding line and a total of six to ten, depending on the calf crop.

The crossbred calves are liable to be limited in number. In cases where there are not enough to divide them under both criteria, breeding will be given priority over previous treatment in assigning the crossbred calves to wintering groups. Heifers will ordinarily be used in the test but steer calves may be included to augment the numbers.

Yearlings

The three yearling groups will be made up of the individuals which were in the calf groups the preceding winter. They will also have been involved in the supplemented vs. unsupplemented comparisons on summer range immediately before entering the wintering study.

As in the case of the weaned calves, yearlings will be assigned to the three wintering groups according to line of breeding and to treatment during the preceding summer. Earlier treatment history will be disregarded.

SUPPLEMENTING YEARLINGS IN SUMMER

Groups and ranges

All yearlings will be divided into two groups during the summer (May to December). They will graze ranges 6 and 7, each of which contains over 90 acres of cane range and adequate forage for at least 20 yearlings during the summer season. One group will receive supplemental feed and the other will not. The groups will be shifted between the two ranges each month to minimize possible effects of range variability.

Depending on the number of animals available (from the wintering treatments,) the groups will have from 9 to 15 head each. Numbers will be comparable between groups during a given year.

Assignment to groups will be on the basis of breeding line and level of supplement during the preceding winter (as weaned calves). Thus, each group will contain animals previously wintered at low, medium, and high levels of supplement, and of three lines of breeding.

Supplemental feeding

Initially, the supplemented group will be fed cottonseed meal at the daily rate of one pound per head. This rate may be increased to two pounds per head, after August or September if such appears to be desirable to maintain an acceptable rate of gain (approximately one pound per day).

FORAGE AND FOREST ASPECTS

Although no intensive investigation of forage and forest aspects is intended in this study, the degree of utilization will be checked periodically. Also, an initial record will be made of the forage stand and provisions made for possible later studies.

For these purposes, 15 milacre plots will be established in each of the winter ranges (3N, 3S, 4N, 4S, 5N and 5S) and 30 similar plots in each of the summer ranges (6 and 7). These plots will be systematically distributed along the edges (one chain from the fence) and through the center of the ranges. Also, at least two fenced enclosures (1/10-acre) will be constructed in each range, and four 1/200-acre plots (two fenced and two grazed) established at each enclosure.

The degree of utilization will be estimated at least twice per season on the milacre plots (and the surrounding 1/10-acre): in A ugust and November on the summer ranges, and in late January and late March on the winter ranges.

The following record of the forage stand will be made on the milacre plots and the 1/200-acre plots at the beginning and end of the study: number and height of living cane stems per square yard (estimated total number or mil-acre plots), foliage density of cane and other forage species and the amount of tree canopy. The same data will be estimated on twentieth-acre plots (26-foot radius), centered at the milacre plots, for an initial inventory of the ranges as a whole.

Cattle:

Complete weight records will be maintained of individual animals during the entire time that they are in all phases of this study (from calves to two-year-olds), including their assignments to groups and ranges.

Nursing calves will be weighed with their dams at approximately two-month intervals.

Weaned calves and yearlings will be weighed monthly.

Feed:

Feed consumed by each group will be recorded daily (except for the creep-fed calves which will be fed less frequently). Pertinent observations regarding feeding and grazing habits of the groups will also be recorded.

Forage:

Forage data will include initial and final inventories of forage plots, and utilization estimates twice each season.

ANALYSIS

The management practices under investigation will be analyzed and interpreted in terms of weight gains or total weight. The results will be evaluated from two viewpoints: proper development of breeding animals, and profitable production of market cattle.

Each phase of the study: creep-feeding of nursing calves, wintering weaned calves, summering yearlings, and wintering yearlings will be analyzed separately, but the effect of previous treatment on subsequent performance will be evaluated. Also, the performance of the three lines of breeding will be evaluated.

The analysis procedures outlined here were suggested by Dr. H. L. Lucas, Experimental Statistics Department, N. C. State College.

Performance of Nursing calves:

In addition to the creep-feeding comparison, performance of calves will be studied in relation to their date of birth in order to obtain information on desirable calving dates for range herds.

Date of birth:

Considering the grazing management of the breeding herds and the creep-feeding treatment, the calf data can be divided into four categories each year for the experiment as a whole:

continuous grazing --- creep-fed
" " --- non-creep-fed
rotational grazing --- creep-fed
" " --- non-creep-fed

In the analysis procedure, sums of squares and products for weaning weight (or weight at a given age) and date of birth will be computed separately for each of the four categories as follows:

Source	D.F.
Between years	3
within years	n-4

(where n = the totwl number of calf records in a particular category)

The regression for weaning weight on date of birth will be obtained from the "within years" sums of squares and products.

Regression coefficients of the four categories will then be tested for homogeneity. Also the average regression coefficient will be tested for significance.

Creep feeding and breeds.

To test whether or not breeding lines and creep feeding have a significant effect on calf weights, the following analysis of variance will be used (for 4 years):

Source	D.F.
Lines of breeding (B)	2
Creep feeding (F)	1
B x F	2
Years (Y)	3
Y x B	6
Y x F	3
Y x B x F (E)	6
Within E	N-24

(N = total number of calf records in the experiment)

The method of unweighted means will be used to overcome the problem of unequal subclass numbers. If the regression of weaning weight on date of birth is significant, and if the average date of birth varies among Y x B x F subclasses, covariance adjustment of weaning weight for date of birth will be made in the above analysis.

Wintering weaned calves and yearlings:

Weaned calves:

Gains or weights of weaned calves, in relation to levels of supplement, breeding lines, and previous creep-feeding, will be analyzed as follows (for one year):

Source	D.F.
Levels (L)	2
Lines of breeding (B)	2
L x B	4
Creep feeding (F)	1
F x L	2
F x B	2
F x L x B (E)	4
Within E	N-18

Yearlings:

The above analysis will also apply to yearlings (summer supplement being analagous to creep-feeding).

Supplementing yearlings in summer:

The effect of the summer supplement treatment, in relation to lines of breeding and level of supplement during the preceding winter, will be analyzed as follows (for one year):

Source	D.F.
Supplement (S)	1
Line of breeding (B)	2
S x B	2
Level of wintering (L)	2
L x B	2
L x B	4
L x S x B (E)	4
Within E	N-18

Initiation and Duration

Summer treatments were started in May 1950. The first wintering trials will begin in December 1950.

The treatments should be continued for 4 years (through the winter of 1953-54) to obtain two creep-feeding trials on each herd and to permit an adequate appraisal of breed differences. At that time three calf crops will have gone through two treatment cycles and will have reached breeding age.

Responsibility

W. O. Shepherd and E. U. Dillard will be directly responsible for technical supervision of the forage management and animal husbandry phases, respectively. R. H. Hughes will be directly responsible for the field work pertaining to forage phases. The Experimental Statistics Department, N. C. State College, will cooperate in the analysis of the data.

General supervision and administration of the research program is under E. H. Hostetler (representing North Carolina State College and the U. S. Bureau of Animal Industry) and R. D. McCulley (Southeastern Forest Experiment Station, U. S. Forest Service).

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RR-SE
RESEARCH PROGRAM
Range Study No. 14 (NCP #36)

FOREST GRAZING STUDIES IN THE COASTAL PLAIN OF NORTH CAROLINA

Working Plan

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SUPPLEMENTAL FEEDING OF CALVES AND YEARLINGS

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The initial comparison will be supplemented vs. unsupplemented; the supplement consisting of one or two pounds of cottonseed meal per head daily. After two years the study may be organized to include different rates of supplementing.

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Due to limited personnel, no detailed studies of forage and forest aspects will be undertaken in this subproject.

An initial forage survey will be made of each range. Also, at least two fenced enclosures, together with fenced and grazed forage plots, will be established in each range prior to grazing. These plots and enclosures will provide a basis for detecting any appreciable vegetational changes.

The degree of forage utilization will be estimated periodically while the ranges are being grazed. The aim is to provide sufficient forage to prevent heavy grazing. If the average utilization of summer ranges (Nos. 6 and 7) reaches 60 percent before the end of the grazing season, the heifers will be moved to a new range.

Initiation:

The study will be started during 1950; treatments I and III in the spring, and treatment II at the beginning of the winter season.

Duration:

The study will run for four years or until definite results have been obtained. Records of the individual animals will be kept so that their performance can be followed for a year or two after treatments.

RESPONSIBILITY

W. O. Shepherd will be directly responsible for the technical supervisions of the forage and forestry phases, and E. U. Dillard for the animal husbandry phases. R. H. Hughes will be immediately responsible for field work pertaining to the forage and forestry phases. General supervision and

administration of the project will be under E. H. Hostetler (representing North Carolina State College, and U. S. Bureau of Animal Industry) and R. D. McCulley (U. S. Forest Service, Southeastern Forest Experiment Station). Major changes in the program and publications will be considered and approved by the directors and heads of the divisions of the various cooperating agencies.

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RR-SE
MANAGEMENT, General
Study No. 13 (NCP #35)

WORKING PLAN FOR A STUDY OF

MANAGEMENT SYSTEMS FOR CANE-TYPE FOREST RANGE

DEFERRED-ROTATION VS CONTINUOUS GRAZING

Prepared by
W. O. Shepherd and E. U. Dillard
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A cooperative project
of
The Agricultural Experiment Station
of the
North Carolina State College of Agriculture and Engineering
with
The North Carolina Department of Agriculture
and
The Forest Service and Bureau of Animal Industry
of the
United States Department of Agriculture

MANAGEMENT OF CANE-TYPE FOREST RANGE

DEFERRED-ROTATION VS. CONTINUOUS GRAZING SYSTEMS

PURPOSE AND OBJECTIVES

The purpose of this study is to develop and evaluate methods of managing forest range and livestock for sustaining a profitable range cattle enterprise in conjunction with other forest uses.

The primary objective is to evaluate deferred-rotation systems of grazing in comparison to the common practice of continuous grazing.

Secondary objectives include an appraisal of:

1. grazing capacity
2. proper degree of utilization
3. fire hazard reduction by grazing
4. effects of grazing on tree reproduction
5. the supplemental feed requirements of breeding cattle wintered on cane range
6. the relative productivity of cattle of different lines of breeding

THE PROBLEM

Research experience has shown that cane is very sensitive to mis-use and it is easily killed by continuous heavy grazing during the summer season. Due to unique physical and biological characteristics of cane range, it is very difficult to achieve the distribution and degree of grazing that will maintain high productivity and still make reasonably full use of the forage under the system of continuous grazing commonly employed. A system of management is needed which will permit efficient utilization, maintain productivity, and be easy for a practical operator to apply. Grazing capacity and acceptable rates of utilization need to be defined, of course, for any system of management.

Less urgent, though important, problems related to forest grazing include the determination of supplemental feed requirements of range cows, and the cattle breeds, or lines of breeding, best adapted to Southeastern ranges. Also, the relation of grazing to important forest management problems, particularly fire hazards and forest regeneration, need to be investigated further in order to fully appraise forest grazing from the viewpoint of integrated resource use in the Coastal Plain region.

IMPORTANCE

Native forage comprises a valuable natural resource of forest lands in the Coastal Plain of North Carolina. From a survey conducted in 1940-41 1/ it was estimated that forest range was furnishing an average of about 30 percent of the yearlong sustenance for over 90 percent of the beef herds in this region. Of the principal forage types, the cane type was found to be the most valuable and most important from the standpoint of current use and future expansion of a range cattle industry. In addition to furnishing nutritious forage throughout the summer months, the cane type can be used for winter grazing under some circumstances.

A recent analysis of forest grazing problems of the N. C. Coastal Plain (May 1950) has brought out the fact that a primary hazard to a stable range cattle enterprise is the danger of destroying the forage stand by improper use. Continued over-use progressively depletes plant vigor and forage production until the cane stand is replaced by other less desirable or worthless species. Once eliminated, there appears to be no practical way of re-establishing a cane stand.

Obviously, the value of the range resource and the chances for its preservation would be greatly increased by the application of a management practice which would maintain the forage stand under reasonably full use. There is reason to believe that the deferred-rotation system may meet this requirement satisfactorily for cane range. If successful, the system will be simple for a practical cattleman or landowner to apply.

SCOPE

On the basis of the recent problem analysis, forage management problems are thought to warrant highest priority in the development of sound forest grazing practices on cane ranges. Therefore, forage management is the primary concern of this investigation. Although cattle and forest aspects will also be studied, these phases have been given secondary consideration in designing the experiment.

A supposedly "improved" system of grazing management, the deferred-rotation system, will be compared with the common practice of continuous grazing. One comparison involving summer and winter ranges, will be on a "practical" scale employing herds of approximately 12 cows each and 70- to 80-acre ranges. A supplemental comparison involving early and late summer ranges will be on a small scale employing 1/2-acre plots or "miniature ranges". The latter will be evaluated in terms of forage stand responses only, while the former will allow grazing capacity and cattle performance comparisons in addition to forage data. Each treatment will be replicated twice, while "overflow" ranges and herds may provide a third replication. Thus, a total of 12 ranges and six herds will be involved.

1/ North Carolina Agr. Expt. Sta. Bul. No. 334, 1942.

The grazing systems will be compared under the same average grazing intensity -- approximately 70 percent average utilization by mid-December. This appears to be about the maximum degree of use tolerated by cane under continuous grazing. However, an evaluation of different grazing intensities will be possible because forage utilization will undoubtedly vary considerably between different parts of a single range, and forage response to different intensities of grazing under each system will be measured on plots distributed throughout the ranges. The main comparison of the grazing systems will be in terms of changes in grazing capacity as the study progresses. Cattle performance will be taken into account, of course, but in previous studies cattle weights have not reflected range deterioration until the range was heavily grazed. It is thought, therefore, that changes in grazing capacity can be measured just as efficiently in cow days of grazing without starving the cows near the end of the grazing season.

The main cattle comparisons will be between lines of breeding since it seems desirable to keep grazing intensity and other cattle treatments (winter supplements, etc.) similar among herds. Africander-Herefords, Brahman-Herefords, and grade Herefords will be distributed among the herds and their performance compared under range conditions. General information will be obtained, however, on the amount of supplemental feed required to maintain breeding cows in thrifty condition during the winter on cane range. This problem has been studied previously at Hofmann Forest but on a slightly different kind of range.

The physical set-up offers an opportunity for investigating the reduction in fire hazard under different systems and intensities of grazing. Although fire protection is an important feature of forest grazing, it will be necessary to postpone such evaluations for at least two years due to limited manpower in view of the requirements of other current studies. Furthermore, fire hazard investigations will be limited to fuel measurements -- no experimental fires are planned.

Although pine seedling responses to grazing warrant further investigation, the design of the experiment will not provide an efficient approach to this aspect of forest grazing because in some of the ranges the age or condition of the forest stand is not suitable for regeneration. Nevertheless, the rates of establishment, mortality, and growth will be compared on the grazed and nongrazed forage plots where pine seedlings do occur. It is doubtful that a good comparison of the two systems of grazing will be obtained in respect to seedling responses. On the other hand, we will likely obtain a fair comparison of grazed vs. ungrazed conditions, and it may be possible to relate seedling response to degree of grazing.

PAST WORK

Most grazing research in the cane type has been conducted under the continuous grazing system, where the cattle were kept on one range throughout the summer and moved to another range or to a farm in winter.

Experimental ranges at Hofmann Forest were so seriously damaged by two years of unintentional over-use with the continuous summer grazing that the proper degree of grazing could not be demonstrated. However, subsequent plot studies there indicated that about 30 percent of the foliage must remain at the end of the grazing season if the vigor and productivity of the cane stand were to be maintained.

A rather conclusive grazing study at the Wenona work center also indicated that 60 to 75 percent utilization of total foliage at the end of the season in November or December is the upper limit of grazing intensity commensurate with sustained yield under continuous grazing.

Repeated observations have shown, however, that cattle seldom utilize a cane range uniformly, and some portions will often be very heavily grazed before other portions are used at all. The usual result is progressive range deterioration from concentration points. Furthermore, in tall cane stands cattle tend to utilize the low forage first (below four feet) and new basal shoots, being succulent and highly palatable, are sought out and kept grazed off. Thus, new stems tend to be eliminated and as the old stems die from breakage or other causes, the stand of cane gradually thins out even though the remaining cane may be vigorous and healthy.

Recent observational data collected at Wenona have provided a clue to an "improved" grazing system for cane. Ranges which had been seriously thinned out and weakened by heavy grazing for three years prior to December 1947, were protected during the summer of 1948 and used for fall and early winter grazing (October to February) that year. A considerable number of new stems were produced during 1948, but they were relatively short (4 to 5 feet tall) in the weakest ranges. The following year, however, many more new stems appeared and they were as large (7 to 8 feet tall) as those of the undamaged ranges. Apparently one year's protection had greatly increased the vigor of the weakened cane stands. This suggests that alternating grazing one summer with protection the next might maintain cane vigor even under heavy use.

Data from plot studies and observation on winter ranges indicate that grazing during the winter months (November to April) is not particularly harmful.

Deferring grazing until winter, then, might be as effective as yearlong protection in maintaining plant vigor. Therefore, a deferred-rotational system, where grazing use is rotated between ranges and seasons and deferred on alternate years, may be a practical means of obtaining sustained productivity without wasting forage.

Two "rotational" systems, mid-summer rotation and 28-day rotation, were compared with continuous summer grazing at Wenona from 1941 through 1944. Cattle performance was similar under all three systems, indicating that grazing can be deferred until mid-summer without sacrificing cattle gains. Vegetational responses were difficult to interpret, because wild fires burned over the experimental ranges three times during the study. Also, the light rate of grazing employed (25 to 45 percent average utilization) could hardly be expected to affect the forage stand appreciably in a short time under any system of management. Furthermore, the mid-season "rotation" was not a rotational system in the usual sense. Rather, one group of ranges were always grazed during the first half of the season and another group during the last half. Observations on the growth habits of cane indicate that deferring use until late summer should permit the establishment of some new stems and help maintain the density of the forage stand. In view of the limitations of the previous study, deferred-rotational grazing of summer ranges seems to warrant further consideration. A mid-season rotational system might be practical if grazing is deferred on alternate years. Such a system would be particularly applicable where winter use is not desired or feasible.

METHODS

Major treatment and range assignment

Under continuous grazing, summer and winter range will be separate. Continuous yearlong grazing on the same range is not practical because, in tall cane, cattle tend to eat the lowermost forage first and it is this low forage which remains green longest and furnishes the best winter forage. Therefore, under this system a herd will graze one range in summer every year and another range in winter.

Under the rotation system, grazing on a particular range will begin with the winter season and continue on through the following summer; then this range will be rested through the next winter and summer.

January through April will be considered as the winter period; and May through December the summer period. About as much range is required for the four months in late winter as for the other eight months.

The treatments will be replicated twice, which will require eight ranges. Four other ranges, allocated as "overflow" ranges for holding surplus cattle, will be managed like the ranges in this study and will essentially provide an additional replication of the treatments except that the degree of utilization may be different.

Assignment of ranges to treatments and replications are as follows (see attached diagram):

Treatment	North Rep. Range No.	North Rep. Area (Acres)	South Rep. Range No.	South Rep. Area (Acres)	"Overflow" Range No.	"Overflow" Area (Acres)
Continuous grazing:						
Summer	13	(86)	17	(60)	12	(130)
Winter	14	(74)	20	(72)	9	(80)
Deferred-rotation grazing:						
Grazed 1950-52-54	15	(77)	19	(73)	10	(100)
Grazed 1951-53-55	16	(70)	18	(73)	11	(93)

Treatments have been randomly assigned within replications with the exception of range number 17 which was not suitable for winter grazing because it has very few trees. Even though the ranges vary somewhat in size, on the basis of preliminary surveys they appear to be fairly comparable in summer grazing capacity. The South replication has the least trees and somewhat wetter soil conditions.

Grazing intensity (rate of stocking)

Initial stocking rates will be similar for all ranges. This initial rate will be approximately six surface acres per cow, although there will be some variation between ranges due to differences in forage stands reflected by the initial range inventories. During the first season of use, stocking will be adjusted to the grazing capacity of the range, and if grazing capacity changes appreciably during the study, stocking will be adjusted accordingly. Adjustments will be made in the breeding line having greatest numbers (grade Herefords). Degree of forage utilization will be the criteria for adjusting stocking rates.

Degree of utilization

The standard of grazing use for the summer season will be an average utilization of 70 percent of the total cane foliage at mid-December. This infers an average utilization approximating 30 percent at the end of July. So far as possible, necessary adjustments of grazing use will be made early in the season.

Undoubtedly, utilization will vary considerable within any one range, and it is anticipated that there will be an opportunity to observe and measure forage responses to summer utilization ranging from perhaps 40 percent to 90 percent.

During the winter grazing period the maximum degree of use commensurate with satisfactory cattle performance will be tolerated, i. e., the cows will be removed from a range only when there is insufficient forage to satisfy their needs. Since the amount of tree cover is expected to have a considerable influence on winter grazing capacity, forest canopy will be evaluated in terms of percentage crown cover.

Measuring major treatment responses

Results will be measured and evaluated in terms of cattle performance and forage responses. Cow and calf gains and calving percentage will be the principle measures of cattle performance. Major forage responses are expected to be reflected by changes in grazing capacity as the study progresses. Careful records will be kept of cow months of grazing use on each range.

More precise evidence of forage response will be obtained from plots distributed throughout the ranges and subjected to varying degrees of utilization.

The forage plots will be of two kinds:

(1) 1/200-acre plots (6.6' x 33'), 16 per range, at four locations or "sites" (2 grazed plots and 2 ungrazed plots at each site). These plots will provide direct comparisons of grazed vs. ungrazed.

(2) Milacre plots (6.6' x 6.6'), 30 per range, systematically distributed throughout the range, will be used to determine average forage utilization of a range and will provide an additional record of forage changes at different grazing intensities.

For the paired 1/200-acre plots, the general location of the plot sites will be at random with the restriction that one site shall fall within each one-fourth of the range (lengthwise). At each site, two comparable 1/10-acre enclosures will be selected; one fenced and the other left open to grazing. Two plots will be randomly located and staked within each enclosure (fenced and open). Initially, and annually, the following records will be made for each plot: estimated foliage density and average height of understory vegetation (by species), estimated number of living cane stems per square yard (new current stems listed separately), average size of cane leaves (length of 3rd primary leaf), percent utilization at the end of the grazing season, and number and height of pine seedlings less than six feet tall (seedlings initially in this catagory will be retained in the inventory regardless of later height growth).

The milacre plots will be regularly spaced along three lines or "transects" running lengthwise through the ranges; one along each side (one to two chains from the fenceline) and one through the approximate center (one chain off the center tractor trail if one is established). (Random distribution of the plots is not practical because of the difficulty involved in finding them). The following records will be made initially and annually on the milacre plots: Average number and height of living cane stems ("new" and "old") per square yard, average number of leafy branches per stem, average leaf size, and the estimated foliage density of cane and other important species. In addition, the degree of utilization (percent of total foliage produced) will be estimated periodically on the milacre plot and also on the surrounding 1/10-acre (37 feet radius). During the summer season, utilization estimates will be made in mid-June, late August, late October, and late December. During the winter season, utilization will be estimated at monthly intervals.

In addition to the permanent plot records, a general forage inventory will be made of each range at the beginning of the study. The following data will be estimated and recorded for 100 temporary plots (20-foot radius) systematically distributed throughout each range: cane height, foliage density, and number of stems per square yard; density of other herbaceous and shrubby species; average number and height of pine seedlings per square yard; and the presence or absence of tree canopy.

Supplementary range treatments

An additional grazing system will be investigated on a "miniature range" basis evaluated only by forage responses. This will be deferred-rotation grazing of summer range where grazing will be deferred until mid-season in alternate years, i. e., a particular unit of range will be grazed from May 1 until August 15 one year, and from August 15 until December 30 the next year.

This supplementary treatment will be obtained by constructing three, $\frac{1}{2}$-acre "miniature ranges" in each of the continuously summer-grazed ranges. The deferred-rotation system will be applied to two of these miniature ranges and the other will be continuously grazed as a check treatment. Fenced enclosures in major ranges will provide a "no grazing" comparison.

Grazing will be at an intensity which will result in approximately 70 percent utilization at the end of the grazing period. In order to assure obtaining the desired amount of grazing, the miniature ranges will be located near the watering places. Over-use will be prevented by closing the gates whenever necessary.

Response of the forage stand will be measured on 10, 3.1' x 3.1', permanent plots in each of the miniature ranges. Initially (spring of 1950) and annually thereafter (in December or January) the following records will be made for the cane in the plots: 1) number and height of new stems (less than one year old) and older living stems, 2) average number of leafy branches per stem, 3) average length of leaves (3rd primary leaf), and 4) estimated foliage density (to be checked in early summer).

Utilization will be estimated on the same plots at monthly intervals. In addition, general utilization will be checked weekly to see that the approximate desired grazing rates are being obtained.

Miscellaneous forest aspects

The response of pine reproduction to grazing will be investigated to a limited extent by comparing seedling establishment, growth, and mortality on the 1/200-acre plots (8 grazed and 8 nongrazed in each major range). Even though the plots are not necessarily comparable as to initial seedling numbers, forest stand, nor pine seed source, it is considered worthwhile to collect the pine seedling data since little additional effort is involved.

The effect of grazing on fire hazard will be investigated at the sites of the grazed and ungrazed (fenced) plots mentioned above. Fuel (loose litter and living material separately) will be collected and weighed on at least two, 3.1' x 3.1', random plots from each of the grazed and fenced enclosures of at least one replication of the grazing treatments. The sampling will be done during dry weather in late winter (February to April). Moisture samples of each kind of fuel sampled will be collected for conversion to an oven-dry basis. In analyzing the data, fuel reduction will be related to degree of grazing as well as system of grazing. Fuel sampling will not be undertaken until after the deferred-rotation system has gone through a complete grazing cycle (December 1951).

Cattle treatments and comparisons

The cows will be treated uniformly except for the systems of grazing. Initially, there will be four herds of 12 to 17 head each (depending on the estimated grazing capacity of the ranges), and two additional herds (probably somewhat smaller in size) in the "overflow" ranges. The herds will be made up of the following lines of breeding: Africander-Hereford, Brahman-Hereford, and grade Hereford. Cattle from each of these breeding lines will be randomly assigned to herds and treatments. The initial assignment to grazing treatment will be maintained as long as the cow remains in the study.

Replacements to the four herds will be from cows which have been on the same grazing system for at least a year in the overflow ranges. Thus, replacement heifers will always be added to the overflow herds. So far as possible, cattle will be removed from the study only at the end of the summer or winter season.

All herds will be fed protein supplement (cottonseed meal) at the same rate during the winter grazing season (January through April). The rate of feeding will be varied as necessary to maintain a thrifty condition of the cows, beginning with two pounds per head daily and increasing to four or six pounds daily as the season advances.

Cattle will be weighed bi-monthly. In addition, birth dates of calves will be recorded, and birth weights will be obtained if feasible.

The question of optimum calving season for range herds will be investigated from the individual calf records by relating preweaning gains and development to birth date. The breeding season will be extended over a full three months so that calves can be expected to be dropped from late February through May. The calves will be weaned at six to eight months of age; the early calves in November and the late calves in December.

The calves will also be involved in another study (Study No. 14) and one herd in each grazing system will be creep fed.

During the first two months of the breeding season it will be necessary to temporarily disrupt the random herd assignment of cows, and to regroup them according to breeds into four to six groups: Africander-Herefords, Brahman-Herefords, and two to four Hereford groups (depending on the availability of bulls). During this time the herds will be shifted periodically among the ranges to equalize and maintain the prescribed grazing rates, and to minimize the chances of a breeding group being influenced appreciably by possible differences in ranges. If it is necessary to graze two ranges with one group of cattle, they will be shifted between the two ranges at approximately weekly intervals.

Breeding groups will be shifted to different ranges each month (or oftener).

During the third month of the breeding season the original herds will be re-established and the bulls will be distributed among the herds. This seems to be the simplest procedure for extending the calving season to investigate desirable calving dates with minimum disruption of the range management treatments. However, it may not permit positive identification of the sires of some of the late calves.

The regrouping and shifting of cattle during the breeding season should not invalidate the results of the study. Previous experience indicates that appreciable differences in cattle gains between treatments are not likely to develop before mid-summer. Furthermore, cumulative changes in grazing capacity will likely be the most pronounced treatment effect and this will be measured in cow months.

Photographs

A photo station will be established at one enclosure in each of the major range units (12 in all) and along the interior north-south fence lines between ranges(9in all). Locations will be selected where reasonably full forage use is expected. Photographs of the forage stand will be taken during the first grazing season (at the early full leaf stage of growth) and at two-year intervals thereafter.

A similar procedure will be followed in the "miniature ranges" where one photo station will be established along each of the interior fences (4 in all).

Supplementary photographs of cattle, forage, range conditions, etc., will be taken as seem desirable.

DATA

Following is a summary of the data to be collected periodically during the study.

I. Cattle

A detailed grazing history will be maintained of individual cows, herds and ranges, including dates of entry and removal from specific ranges, amount of supplemental feeding, and any pertinent occurrences or factors observed such as illness, accidents, etc.

Cattle will be weighed at the beginning of the wintering period (about Januaryl) and the summering period (about May 1), and at 2-month intervals throughout the year.

Calves will be weighed with the cows and also at birth and weaning.

II. Forage inventories will be made at the following times:

A. Major ranges (including overflow ranges) Nos. 9 to 20 inclusive: 1/200-acre plots (8 per range): at beginning of the study and once each year thereafter in late winter. (Forage density and leaf size to be estimated in early summer).

B. "Miniature Ranges" (6 total):
3.1' x 3.1' plots (10 per "range") at beginning of study (spring 1950) and annually thereafter in early winter (December or January). (Foliage density to be estimated in early summer).

III. Utilization estimates:

A. Milacre plots in Major ranges (30 per range):
Summer grazed (6 ranges per year)--mid-June, late August, late October and late December.
Winter grazed (6 ranges per year)--late February, late March, and whenever a herd is removed from a winter range.

B. 1/200-acre plots in Major ranges (8 per range):
Summer grazed--near end of grazing season (December).
Winter grazed--near end of grazing season (March or April).

C. Small plots in "Miniature ranges" (10 per range):
Rotation "ranges"--grazed "early": Monthly from May to August.
Rotation "ranges"--grazed "late": Monthly from September to December.
Continuous "ranges": Monthly from May to December.

IV. Photographs:

Photo stations will be photographed at two-year intervals (in early summer) and at such other times as seems desirable.

STATUS

All ranges have been installed, and the ranges were grazed according to plan during the winter period beginning in January 1950.

All enclosures and associated plots were established and inventoried prior to January in the eight ranges of Rep. 1 and Rep. 2, and half of them in the overflow ranges. The latter will be completed in the spring of 1950.

The utilization plots (milacre) will be established early in the summer grazing season of 1950.

DURATION

The range treatments will run at least four years and preferably six years. The deferred-rotation system will have gone through two grazing cycles by December 1953. The results by that time will indicate whether continuation in the original form is desirable.

ANALYSIS

Within the limits of practicability, the study has been designed to permit the application of statistical techniques as an aid in the interpretation of the results. The relatively simple analysis of variance procedure will be employed in most cases. The analyses outlined on the following pages are based on two replications. It may be possible to include the results of the overflow ranges as a third replication for some comparisons.

Some observational data obtained from the study, such as the approximate supplemental winter feed requirements of the cows, will not be suitable for statistical treatment, and must be interpreted and evaluated according to previous research experience and the judgement of the investigators.

The analyses presented have been suggested by Dr. H. L. Lucas, N. C. State College, Department of Experimental Statistics.

I. Cattle phases

In evaluating the two systems of grazing, grazing capacity will be measured by cow days of grazing per acre, and forage quality by gain per head. Winter and summer seasons (or portions thereof) will be analyzed separately. Gain per head will be calculated from the cows remaining on each range for the entire season under consideration. If there are appreciable differences in calving percentage between herds, gains of dry cows and cows with calves can be analyzed separately. To provide a uniform basis of comparing grazing capacity in case forage stands differ initially between ranges, surface acres can be converted to "forage acres" by adjusting for the initial density and height of cane in accordance with the relationships worked out in Subproject 12 (at Tidewater Station).

The following analysis will apply to individual cow data such as gain per head (shown for 4 years and 2 replications):

Source	d.f.
Treatment (T)	1
Replication (R)	1
R x T	1 (error a)
Breeds (B)	2
B x T	2
B x R	2
B x T x R	2 (error b)
Years (Y)	3
Y x T	3
Y x R	3
Y x T x R	3 (error c)
Y x B	6
Y x B x T	6
Y x B x R	6
Y x B x T x R (E)	6 (error d)
Cows within E	(n-48)*

* Where n = the number of cow records used.

Due to varying numbers of cattle in the 3 breeds from year to year, the method of "unweighted means" (Snedecor, 4th Ed., P. 287, 294) will probably be used for the above analysis.

Portions of this analysis can be used for testing separate parts of the experiment. For example, the following will apply for comparing average gains per head of the three breeds (for one year or the average of two or more years):

Source	d.f.
Treatment (T)	1
Replication (R)	1
R x T	1
Breeds (B)	2
B x T	2*
B x R	2*
B x T x R	2-

* Pooling of these interactions for an error term for testing breeds will probably be justified.

Similarly, for testing treatment differences on the basis of herd performance (cow days of grazing per acre, gain per acre, etc.) the following will apply (for 4 years and 2 reps.)

Source	d.f.
Treatment (T)	1
Replication (R)	1
R x T	1
Years (Y)	3
Y x T	3
Y x R	3
Y x T x R	3

(In case the data from the overflow ranges is suitable for a third replication, the degrees of freedom for R x T will be increased to 2, and Y x R and Y x T x R to 6 each).

From past experience, marked differences in calving percentages are not anticipated in this study. If apparent differences should develop they can be tested with the above analyses. Percentages will be transformed to angles (arc-sin transformation) before analyzing.

The performance of the calves, including the effect of breeds and birth dates, will be evaluated in the analysis of creep feeding in Study No. 14.

II. Forage phases

Forage responses will be evaluated in terms of measurable indicators of plant vigor and productivity such as number and size of new stems or total stems, number and size of leaves, or simply foliage "density". The final results of Subproject 12 (at Tidewater Station) will probably provide a basis for computing a single index of productivity from a combination of such indexes.

Forage data from the major ranges and the "miniature ranges" will be analyzed separately.

Major ranges

The major ranges provide essentially three treatments from the standpoint of forage response: continuous summer grazing, continuous winter grazing, and rotational winter-summer grazing. But for any one year the rotation treatment breaks down into two treatments: currently grazed and currently protected. Therefore, the plot data can be analyzed on the basis of four treatments, rotation ranges being separated according to the year they were first grazed (1950 or 1951).

Milacre-plot data can be averaged for each range and analyzed as follows (for 4 years):

Source	d.f.
Treatment (T)	3
Replication	1
R x T	3
Years (Y)	3
Y x T	9
Y x R	3
Y x T x R	9

To investigate the proper degree of utilization without resorting to highly complicated curvilinear analysis, forage response (indexes of vigor and productivity) will first be plotted against degree of utilization (at the latest critical date indicated in Subproject 12). From an inspection of the plotted data, the indicated maximum acceptable degree of utilization will be approximated for each range. The preceding analysis can then be applied to these approximated values to test the hypothesis that proper utilization varies between grazing treatments.

The 1/200-acre-plot data will provide a nongrazed comparison as well as an additional (though less intensive) evaluation of the treatments already discussed.

An appropriate analysis on an individual plot basis is as follows (for one year):

Source	d.f.
Replication (R)	1
Treatments (T)	3
T x R	3
Sites within T x R (S)	24
Grazed vs Ungrazed (G)	1
G x R	1
G x T	3
G x R x T	3
G x S	24
Plots within G x S	64
Total	127

Covariance can be applied to the above analysis if adjustment for initial values, or for degree of utilization, is desired. The effect of tree canopy on forage values can also be evaluated with the covariance procedure.

Analyzing differences between grazed and ungrazed plots at each plot "site" (four in each range) offers a simpler approach which may prove to be adequate for some comparisons. The analysis would be as follows (for one year and two replications):

Source	d.f.
Replications (R)	1
Treatment (T)	3
R x T	3
Sites within R x T	24
Total	31

"Miniature ranges"

Although only two grazing systems are being compared on the ½-acre ranges, essentially three conditions (or "treatments") will exist at any one time due to the deferred-rotation management.

Since the forage stand and degree of utilization are expected to be reasonably uniform within the "ranges", forage responses on the small plots can probably be analyzed on the basis of range means. The following analysis is appropriate for one year (on current values or difference from initial values):

Source	d.f.
Replications (R)	1
Treatment (T)	2
T x R	2
Total	5

For four years the analysis would be

Replications (R)	1
Treatment (T)	2
T x R	2
Years (Y)	3
Y x R	3
Y x T	6
Y x T x R	6
Total	23

In case there is considerable variability in forage response which appears to be related to measurable factors such as degree of utilization, or cane size, regression techniques will be used to evaluate the relationships on an individual plot basis.

III. Forest phases

The analysis outlined for forage evaluations on the 1/200-acre plots will also apply to fuel and seedling data, although for the latter, some adjustments will need to be made for unequal subclass numbers which will occur.

In evaluating pine seedling establishment, only the sites having a seed source will be studied.

Comparisons of seedling growth rates will be made only on sites having seedlings in both grazed and fenced plots.

ASSIGNMENT

Under the general direction of E. H. Hostetler, E. U. Dillard will be responsible for all cattle management phases including the supervision of the herdsman in handling the cattle and making cattle records.

The forage and forestry phases will be under the general direction of R. D. McCulley, and the technical supervision of W. O. Shepherd. Ralph H. Hughes will be responsible for the field work pertaining to the collection of forage and forest data.

The Statistics Department of N. C. State College will cooperate in the analysis of all phases of the data.

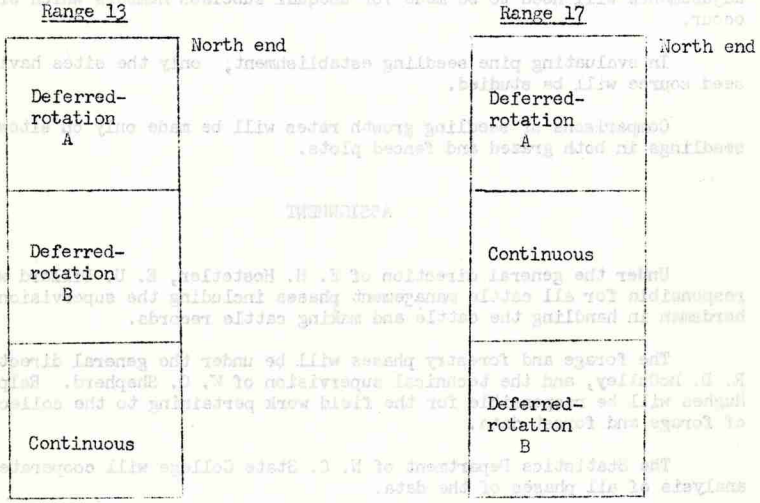


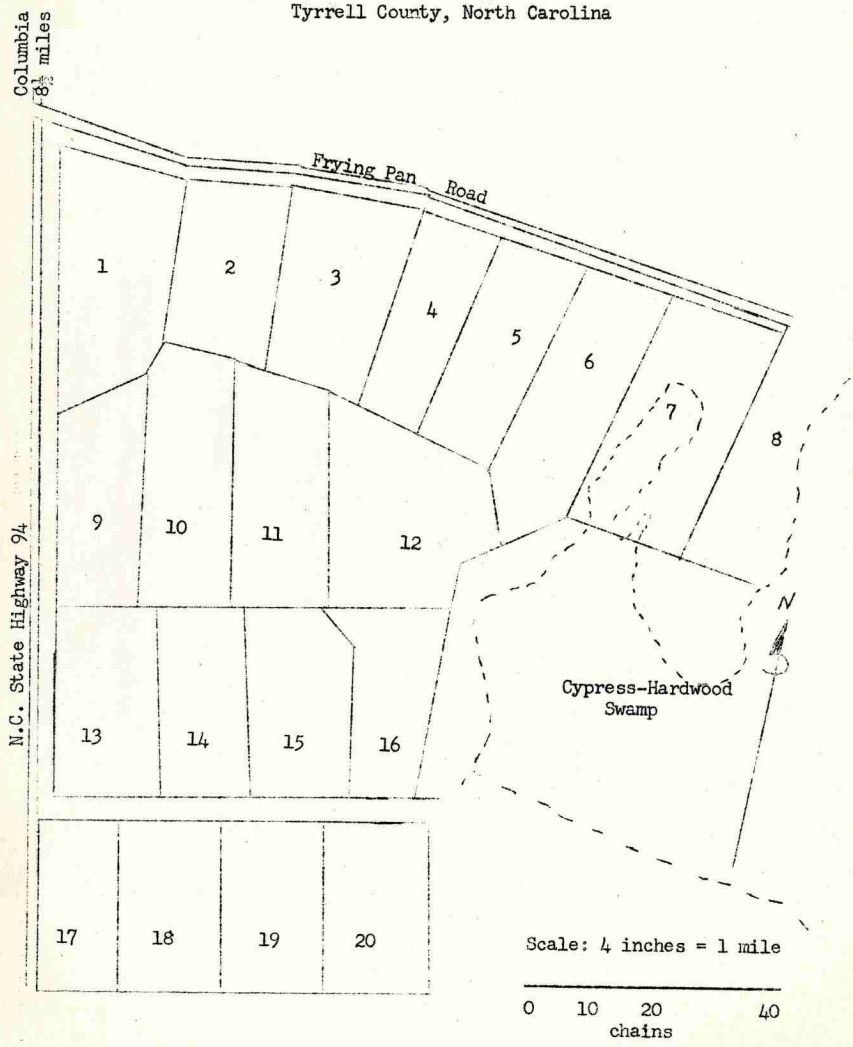
Figure 2.--Diagram of the "miniature ranges" located in Ranges 13 and 17, and treatment assignments.

Deferred-rotation = grazing use rotated between early summer (May 1 to August 15) and late summer (August 15 through December) on alternate years.

(A) grazed early in 1950-52 and late in 1951-53;
(B) grazed late in 1950-52 and early in 1951-53.

Continuous = grazed continuously from May to December every year.

FRYING PAN EXPERIMENTAL RANGE
Tyrrell County, North Carolina



FINAL REPORT, COMPLETED ~~OR REVISED~~ PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: PURNELL P14-s13, UTILIZATION OF REEDS IN FOREST GRAZING.--II, WINTERING CALVES ON REED PASTURE(WINONA) (SUBPROJECT No.6)

2. Departments and cooperating agencies: An. Ind., N. C. Dept. of Agr.,Bureau of Animal Industry, U.S.Dept. of Agr., and U. S. Forest Service.

3. Major personnel: J. E. Foster, H. H. Biswell, F. H. Hostetler, and J. L. Rea, Jr.

4. Date begun: November 1942 Date revised/completed: Revised May 1950
If discontinued without completion state reasons:

5. Estimated total cost by funds (salaries and maintenance): $4000

6. The problem (briefly restate its nature, importance, and economic significance):
The wintering of cattle, particularly young cattle, is an expensive period in the operation of the beef cattle enterprise. In areas of the Southeastern Coastal Plain where cane is utilized in the production of beef the wintering of young stock is a critical problem. Supplemental feeding of young calves in conjunction with the grazing of small grain on the farm has been the method most generally employed. The fact that many cattle are produced almost entirely on cane ranges makes the question of how to feed and manage herd replacement stocker cattle important. This study was devised to investigate the feeding of supplements to calves on cane range in winter in comparison with wintering calves on the farm.

7. Major results and conclusions:
Only two trials were conducted in this study before it was discontinued when the location of the experiment station was moved. In the two trials conducted it was found that calves wintered on the farm made greatest gains in the winter but smallest summer gains. Small differences were found in rate of gain between calves on cane range receiving two and four pounds of supplement in favor of the four pound group. Most economical gains were made by the calves on cane receiving two pounds of cottonseed meal per head per day. At the end of the following summer during which all calves were grazed together it was found that there was very little difference in weights as the summer gains had been in inverse proportion to winter gains. Not enough work has been done to warrant definite conclusions.

(over)

*Three copies to be sent to the Office of Experiment Stations.

8. Practical applications and public benefits achieved or in prospect:

On good cane ranges such as that at Wenona it may be possible to winter calves satisfactorily on cane range with a protein supplement, however, most of the range available is not of such high quality. Whether or not young cattle can be wintered satisfactorily on the poorer ranges is still an unanswered problem. The revision of this project as a part of sub-project No. 14, "Producing Replacement Cattle for Range Herds: Supplemental feeding of calves and yearlings for better development on winter and summer range".

9. Publications:

None

Director

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1950
(Three copies to be given to the OES examiner)

1. PROJECT: (Fund, number, and title): PURNELL ~~Regional (?)~~ P14-9, UTILIZATION OF REEDS IN FOREST GRAZING.--9, EFFECT OF DEGREE AND SEASON OF DEFOLIATION ON THE PRODUCTIVITY AND VIGOR OF SWITCH CANE. (Subproject No. 9)

2. DEPARTMENTS AND COOPERATING AGENCIES: Animal Industry, Bureau of Animal Industry, U. S. Forest Service, N. C. Department of Agriculture.

3. PERSONNEL: W. C. Shepherd, R. H. Hughes, and E. U. Dillard.

4. NATURE OF WORK AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked):

In this study, hand harvesting on small plots was used to investigate the effects of several degrees of defoliation at different seasons of the year on the vigor and productivity of switch cane ("reed"). Three years of treatment were concluded at the end of 1948. General results, as indicated by forage yield, stem counts, etc., were included in the 1949 Progress Report.

For an additional evaluation of the treatments, stems and rhizomes were harvested in March 1949 from all plots and samples were collected for carbohydrate determinations. Chemical analyses of these samples had not been completed as of Jan. 1, 1950.

5. BENEFITS realized by farmers or the public through application of findings, stated in dollars, bushels, or other values, where possible:

Results obtained in this exploratory study will provide basic information for developing better management of cane range--- a valuable natural resource which is easily destroyed by misuse.

6. WORK PLANNED FOR NEXT YEAR:

Field work on this study has been closed out. During 1950, carbohydrate determinations will be completed and all data analyzed. The present plan is to incorporate the results of this study with two other closely related studies (Nos. 10 and 12) for final publication.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

Two chemical analyses to be made - will be written up by June 1951 -

8. APPROVED: _____ _____
Project Leader. Director.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1950
(Three copies to be given to the OES examiner)

1. PROJECT: (Fund, number, and title): PURNELL ~~(gran.(f)~~ P14-10, UTILIZATION OF RESEDS IN FOREST GRAZING.--10, ORGANIC FOOD RESERVES OF SWITCH CANE IN RELATION TO SEASON AND STAGE OF GROWTH. (Subproject No. 10)
2. DEPARTMENTS AND COOPERATING AGENCIES: Animal Industry, Bureau of Animal Industry, U. S. Forest Service, N. C. Department of Agriculture.
3. PERSONNEL: W. O. Shepherd, E. U. Dillard, and R. H. Hughes.
4. NATURE OF WORK AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked):

An investigation of "normal" levels and fluctuations of food reserves of ungrazed cane in relation to annual growth cycles. Final field samples were collected in March 1949. Chemical determinations of the 1948 samples were completed during 1949. Early results (see 1949 report) indicated wide seasonal fluctuations in food reserves with lowest levels in early June. Recent data reflect less drastic depletion of reserves during the rapid growth period, and suggest that in 1947 the cane had not fully recovered from a 1945 fire which killed all aerial stems. Such information has an important bearing on the management of cane range.

#9 and 10 will be published together-

5. BENEFITS realized by farmers or the public through application of findings, stated in dollars, bushels, or other values, where possible:

The results of this study are particularly useful for determining the growth requirements of this species and for explaining the effects of different management treatments. This kind of information should be of vital interest to farmers and cattlemen who are concerned with proper management for sustained range productivity.

6. WORK PLANNED FOR NEXT YEAR:

Final chemical determinations will be completed early in 1950. The results will be incorporated with those of two other closely related studies (Nos. 9 and 12) for final publication according to present plans.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

"The application of the Total Available Carbohydrate Method to the Study of Carbohydrate Reserves of Switch Cane (Arundinaria tecta)", Ivan Lindahl, R. E. Davis, and W. O. Shepherd. Plant Physiology, Vol. 24, No. 2, pp. 285-294, 1949 - (April).

8. APPROVED: _____ _____
Project Leader. Director.

Project File
P 14

North Carolina State College of Agriculture and Engineering
of the
University of North Carolina
Raleigh

SCHOOL OF AGRICULTURE AND FORESTRY
AGRICULTURAL EXPERIMENT STATION
AGRICULTURAL EXTENSION SERVICE
RESIDENT TEACHING

STATE COLLEGE STATION

February 22, 1950

DEPARTMENT OF ANIMAL INDUSTRY

Dr. D. W. Colvard
Campus

Dear Dr. Colvard:

In the lease for land in Tyrrell County which we are using in our forest grazing work we are supposed to furnish the Richmond Cedar Works with a report of progress. I am sending a copy of this report to Mr. O. B. Hayes, president of the Richmond Cedar Works and thought you would be interested in a copy.

Very truly yours,

Earl Hostetler

E. H. Hostetler
Professor and Head
Animal Husbandry Section

Enc.

Raleigh, North Carolina

21 February 1950

MEMORANDUM TO PROFESSOR E. H. HOSTETLER:

Reference - Letter of O. B. Hayes

Work was started on the Frying Pan Experiment Range about Nov. 15, 1948. The first job undertaken was to make a forage and timber survey at quarter mile intervals over the two mile square lying in the southeast corner formed by the junction of the Frying Pan road and Highway No. 94. The interior quarter of this tract was found by this and earlier reconnaissance to be a cypress swamp and unfit for grazing research.

Fencing operations were started about Dec. 1, 1948 and at the present time something over twenty miles of fences have been constructed. It has been possible to use trees for fence posts to a very large extent. When this is done board strips are first put on the trees and then the wire stapled to the strip. Approximately 1500 fence posts and near 3000 pieces of reject handle stock (used as soreaders between fence posts or trees) have been purchased.

A tool shed approximately 8 x 8 feet, a feed house 8 x 16 ft. with scale shed of same size attached, a feed house 8 x 12 ft. and several pens for holding and separating cattle have been built at the site. A lane approximately 150 ft. in width has been fenced off along the Frying Pan road, along Highway 94 and along the old logging road near the southern boundary of the tract. These areas were grazed rather heavily in 1949 to help in fire control for the area. At the present time nine (9) ranges averaging about 70-acres in size have been fenced and eight (8) more surveyed preparatory to fencing.

The first cattle (36 in number) were moved to the area Jan. 25, 1949. These were all cows and calved on the ranges in early 1949. In addition to the first group of cows another group of approximately 45 cows and 25 calves was moved to the area the latter part of July. Rains were rather frequent from shortly after the first cows were moved to Tyrrell County on through 1949 and while the cows did fairly well the calves were not as large at weaning time (November) as we had hoped for. It was not unusual during a large part of the year for water to be standing over most of the areas fenced. The drainage canals were practically full the year long. According to residents of the area the year 1949 was much wetter than usual. We certainly hope the others aren't as wet.

An investigation of the possibility for establishing strips of improved pasture for firebreaks was started in 1949. Four different grass species and four legumes were seeded in March on plots prepared by disking, or burning, or disking after burning. Early stands of all species were fairly good, but heavy rains flooded the site during the summer and killed most of the young pasture plants. The plants that survived the flooding, however, are doing well as of February 1950. We expect to put in another trial this spring, on the assumption that last summer was unusually unfavorable.

During the year we have had cattle at the range two cows and a bull have died of unknown causes, one cow died of impaction of the rumen and two cows are reported missing since August 1949. Two calves were found dead in early 1949 that had apparently died at birth or shortly thereafter. One calf (born weak) has died thus far in 1950. This number of losses exceeds that we had suffered in earlier forest grazing elsewhere, but may have been due, at least in part, to 1949 being an extremely wet year at this location.

A grazing experiment, involving eight forest ranges (about 70 acres each) was begun in Jan. 1950. This study is expected to yield the following information:

1. Grazing capacity of this type of range under two systems of management.

2. Supplemental feed requirements of cows wintered on forest range.

3. Productivity of range herds in terms of saleable calves.

Supplemental data will be obtained on:

a. Fuel reduction by grazing.

b. Effects of grazing in pine seedling establishment and growth.

c. Relationships between timber stand and forage production.

Future plans:

Plans are being made, and eight (8) additional ranges are being fenced, for starting studies in November 1950 on problems of wintering calves and yearling cattle on range.

E. U. Dillard
Assistant Professor
Animal Husbandry

P14

19 December 1949

MEMORANDUM TO: Prof. E. H. Hostetler, Head
Animal Husbandry Section

In reviewing some of our projects with Associate Director Cummings, it appears that the working plans for Purnell project P14 are quite well worked out but that the subprojects which have been completed or discontinued are still included in the work plans to the extent that it is quite difficult to understand just what projects are active and what the plans for the next year include. With this in mind I would like to suggest that those concerned with the project consider rewriting the working plans to include only the work which is now active and which will be active in the immediate future. This can probably be done without a great deal of effort since apparently the workers have given considerable thought to the matter.

D. W. Colvard, Head
Department of Animal Industry

DWC:ho

North Carolina State College of Agriculture and Engineering
of the
University of North Carolina
Raleigh

SCHOOL OF
AGRICULTURAL AND FORESTRY
RESEARCH EXTENSION
RESIDENT TEACHING
AGRICULTURAL EXPERIMENT STATION

OFFICE OF DEAN AND DIRECTOR

November 16, 1949

MEMORANDUM TO: D. W. Colvard

In reviewing the material which you supplied me relative to project analysis and working plans for Purnell project P-14, I should like to suggest that the complete project outline be reviewed and a revised proposal prepared for submission to the Office of Experiment Stations. I understand from our conversation that Dr. Shepherd is on the West Coast at the present time and that this will need to await his return. I understand that the plans are in good shape and that a revision of the outline should be a relatively simple matter. However, I believe that we need to prepare this revision in order to clarify the records in this office and the Office of Experiment Stations in Washington. I am transmitting the copy of the working plans for 1948 studies to the Office of Experiment Stations and would appreciate your supplying me with another copy if available.

Sincerely yours,

R. W. Cummings

R. W. Cummings
Associate Director

29 October 1949

Dr. R. W. Cummings
Associate Director
N. C. Agricultural Experiment Station
Campus

Dear Dr. Cummings:

You will find enclosed a copy of "First Supplement to the Project Analysis and Working Plans for Studies in the Coastal Plain of North Carolina, Second Revision, March 1945." This supplement was prepared in October, 1947, and gives the status of the work under several of the subprojects of Purnell Project 14, "Utilization of Reeds in Forest Grazing," referred to in Dr. Elting's letter of September 23. In answering the questions which Dr. Elting raised, it is correct that some of the work formerly conducted under Subproject 2 is now being carried out under Subproject 6.

On Subproject 7, "Relative Grazing Values and Nutritive Properties of Forage," samples have been sent to N. R. Ellis of the Bureau of Animal Industry for carbohydrate analysis. The field work has been completed, but there remains some laboratory analyses and final summaries which will be completed during this winter.

Subproject 8, "Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina," is active and you will find enclosed a statement of the breeding plans for the year 1949-50. Subprojects 11 and 12 are now active at the Plymouth Station and at the Frying Pan area, Tyrrell County.

Sincerely yours,

D. W. Colvard, Head
Department of Animal Industry

DWC:ho
Encls.

Copy

North Carolina

S46-ai17 - P14

The Breeding plans for the year 1949-50.

Inter se matings will be continued within the Brahman-Hereford and Africander-Herford crossbred groups. A bull from the inbred line being developed from the Africander-Angus crossbred foundation at Jenerette may be used in the Africander crossbred group during the 1950 breeding season.

During the 1949 breeding season a part of the grade Hereford cows were bred artifically with semen of Romo Sinuano bulls in Colombia, S.A. Those not so bred and those failing to settle were exposed to pasture service to a Brahman bull. One Romo Sinuano x grade Hereford heifer calf was dropped in June. About 12 calves of this breeding are expected in the 1950 calf crop.

One Africander-Hereford F_2 bull calf and one Brahman-Hereford first cross bull calf will be fed for 6 months in comparison with purebred Hereford bull calves in the bull testing program at Raleigh during the winter of 1949-50. If a suitable bull calf is available from the herd at Jenerette, he will be fed with this group. These bulls may be future herd sires within their own breeding groups.

A study has been made of the accumulated data. Briefly, the crossbred groups have given feedlot and reproductive performance superior to that of grade Herefords. The grade Hereford steers have graded higher than the crossbred groups both as feeders and slaughter cattle, but differences in carcass value are not evident.

10/11/49

THE RÔLE OF FOREST GRAZING IN BEEF CATTLE PRODUCTION IN THE SOUTHEASTERN UNITED STATES

PROJECT ANALYSIS AND WORKING PLANS FOR STUDIES IN THE COASTAL PLAIN OF NORTH CAROLINA

SECOND REVISION
- March, 1945 -

By

J. E. Foster and H. H. Biswell

A cooperative project
of
The Agricultural Experiment Station
of the
North Carolina State College of Agriculture and Engineering
with
The North Carolina Forestry Foundation
The North Carolina Department of Agriculture
and
The Forest Service and Bureaus of Animal Industry and Plant Industry,
Soils, and Agricultural Engineering, of the United States
Department of Agriculture

FOREWORD

The first copy of the project analysis and working plans was written in the winter of 1941-42, and revised June 20, 1942. Three of the subprojects outlined in the revised copy have now been completed or closed out. To fulfill all the general aims of the working plan, an up-to-date revision is needed. The main purpose of this revision is to outline new subprojects to be started in the Coastal Plain, and to bring up-to-date the status of each subproject outlined in the revised copy of June 20, 1942.

Although the project analysis covers all phases of beef cattle production and grazing in the Coastal Plain, the working plans are limited mainly to the forestry grazing phases for which special appropriations for their study were made in 1940. Other phases of beef cattle production, including other types of grazing, in the Coastal Plain are considered in other working plans and projects of the North Carolina Agricultural Experiment Station. The reader, therefore, should not gain the idea that other important phases of cattle production and grazing in the Coastal Plain are being neglected.

This project analysis and outline of working plans has proved to be invaluable on the forestry grazing project. It has proved especially valuable because of the large number of agencies cooperating. General aims of the project analysis and working plans have been, and are, as follows:

1. To provide a thorough understanding of the problems of forest grazing in the Coastal Plain and their importance and scope.

2. To insure a thorough-going attack on the problems.

3. To guide the execution of the work and insure that pertinent data are collected regardless of change in personnel or change in viewpoint of existing personnel.

4. To inform station directors, chiefs, and heads of divisions of methods of attack and how the work is being done.

5. To serve as a schedule for the preparation of reports and publications.

It is proposed that the working plans be rigid enough to insure that the original intent is attained, yet general and flexible enough to permit necessary revision and the investigation of "sidelight" problems. As the work progresses and more information is obtained, it will be necessary to make certain changes in technique,

but no changes should be made before seeing whether such changes can be incorporated successfully without endangering the primary objectives of the studies. Minor changes may be approved by the project leaders who are responsible for the technical phases of the studies, but any necessary major changes should be approved also by station directors, chiefs, and heads of divisions of the various cooperating agencies. All changes should be in the form of written supplements.

The subprojects herein outlined have been reviewed by representatives of all cooperating agencies and general approval obtained. Professors Gertrude M. Cox, R. E. Comstock, and J. A. Rigney of the Statistical Section of the North Carolina State College have kindly considered and have approved all subprojects from the statistical point of view and have suggested and written out the analyses presented.

As certain of these subprojects are completed working plans will be developed for others.

J. E. Foster and H. H. Biswell

CONTENTS

THE ROLE OF FOREST GRAZING IN BEEF CATTLE PRODUCTION IN THE SOUTHEASTERN UNITED STATES

PROJECT ANALYSIS AND WORKING PLANS FOR STUDIES IN THE COASTAL PLAIN OF NORTH CAROLINA

SECOND REVISION, March 1945

By

J. E. Foster and H. H. Biswell[1/]

INTRODUCTION

Experimental work and general observations, as well as the experiences of many stockmen, indicate that cattle raising and timber production fit very well together on many forest areas in the southeastern United States. This is the case on cutover lands, particularly, where the raising of beef cattle furnishes some annual income to the farmer while the trees are growing to merchantable size; furthermore, the grazing affords protection to the trees through reducing the forest fire hazard. Some studies started in 1940 in the Coastal Plain were primarily to determine how timber production and cattle grazing can be most satisfactorily fitted together. The development of improved practices and the proper correlation of the grazing of forest lands with that of tame pastures, field crops, and feeds, together with improved livestock management, afford a possibility of deriving greater

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1/ J. E. Foster, North Carolina Experiment Station and Bureau of Animal Industry, U. S. Department of Agriculture; H. H. Biswell, Appalachian Forest Experiment Station, Forest Service, U. S. Department of Agriculture.

returns from these lands than from the growing of timber alone or the production of beef alone.

The studies are located in the Coastal Plain of both North Carolina and Georgia and are conducted by state and federal agencies cooperating. The analysis and working plans presented here are for the experiments in North Carolina and are based largely on conditions and practices in this area.

Many forest areas in the southeastern states have been heavily cut during the war and the acreage of cutover land to be managed and regrown to timber is still increasing. Therefore, the results from these studies will apply to a still larger acreage than at present.

CONDITIONS AND PRACTICES IN FOREST RANGE MANAGEMENT IN THE COASTAL PLAIN OF NORTH CAROLINA

The statements in this section are based largely, but not all together, on a survey of forest grazing in the Coastal Plain of North Carolina, in the fall and winter of 1940-41, primarily to learn more specifically about present methods of handling beef cattle herds and forest grazing lands in this area. Also, to find the results obtained by operators, and to discuss with them their experiences and chief problems in raising cattle and growing trees on the same land. The results of this survey are presented in more detail in bulletin form (3).

General Description of the Coastal Plain of North Carolina

The Coastal Plain of nearly 15 million acres includes 44 counties in the eastern part of the state. It is primarily a forest and farm region, with forest lands comprising 64 per cent of the unit(11, 12). The eastern one-third, commonly called the Tidewater Section, is a low, level, poorly drained area characterized by extensive swamps and sluggish rivers. The other portion, the western Coastal Plain, with a gently rolling topography, is well drained, but, because none of the slopes are very steep, soil erosion generally is not a serious problem. The five main forest types in the Coastal Plain and the approximate percentage of each are the loblolly pine-hardwood, 43 per cent; bottom land hardwood, 22 per cent; pond pine-hardwood, 21 per cent; longleaf pine, 8 per cent; and upland hardwood, 6 per cent. Many forests have an undesirable, almost impenetrable

brushy undergrowth, and therefore are not well suited to grazing. The main brush species here are gallberries (Ilex spp.), waxmyrtles (Myrica spp.), bays (Magnolia virginiana, Persea pubescens, and Gordonia lasianthus), huckleberries (Vaccinium spp.), laurels (Kalmia spp.), and species of Smilax (Smilax spp.).

Agriculture is the leading industry in the Coastal Plain, with the important cash crops consisting of tobacco, cotton, corn, peanuts, and potatoes. The acreage of certain of these has decreased in the past few years and that of small grains, hays, and tame pastures has increased. This change has favored cattle production.

Forage Types

The forage available for grazing in the forest areas of the Coastal Plain of North Carolina can be classed in five generalized types on the basis of the most abundant palatable plants present. The generalized types and the approximate percentage of each are the reed or switch cane, 30 per cent; woodsgrass, 30 per cent; broomsedge, 25 per cent; wiregrass, 14 per cent; and marshgrass, 1 per cent. In some places, of course, it is difficult to classify the forage on this basis because the dominant species of two or more types may be present in about equal abundance. Except for the marshgrass type, the various forage types are almost wholly in wooded areas.

As far as cattle grazing is concerned, the reed or switch cane type is the most important and most extensively used. Also, the possibilities for expanding forest grazing in the Coastal Plain appear to be greatest in this type because there are large areas of it not being grazed at present. Areas of reeds apparently have been greatly reduced in size in the past because of overgrazing and fires (19). Proper management of reed areas for sustained forage yield is a problem needing considerable study. The comparative amounts of grazing furnished by the different forage types in 1940-41 when the survey was made were approximately as follows: reed, 46 per cent; woodsgrass, 18 per cent; broomsedge, 33 per cent; wiregrass, 2 per cent; and marshgrass, 1 per cent. The reed type is suitable for grazing practically all of the year, whereas the woodsgrass, broomsedge, and wiregrass types are good for only spring and early summer grazing, and the marshgrass type mainly for winter. While some of these can not be used very long each year, they usually furnish grazing at a time when other feeds are scarce and for this reason are more important than the length of their use indicates.

Some of the main forage species in the different types are as follows: reed type -- reed (Arundinaria tecta) and Panic grasses (Panicum spp.); woodsgrass type -- bluestems (Andropogon spp.),

Panic grasses, and sedges (Carex spp.); broomsedge type -- yellow-sedge bluestem (Andropogon virginicus), and other bluestems; wiregrass type -- threeawn (Aristida spp.), muhly grasses (Muhlenbergia spp.), and dropseeds (Sporobolus spp.); marshgrass type -- rushes (Juncus spp.) and salt-tolerant grasses.

Browse Plants and Poisonous Plants

Several vines, shrubs, and trees in the Coastal Plain furnish some browse, although none are exceptionally good. However, these supply feed mainly in winter and early spring when herbaceous forage is scarce. Vines commonly browsed are honeysuckles (Lonicera spp.) and laurel greenbriar or smilax, chiefly during the winter. Among shrubs taken to some extent are myrtle dahoon (Ilex cassine var. myrtifolia), American cyrilla (Cyrilla racemiflora), summersweet clethra (Clethra alnifolia), common sweetleaf (Symplocos tinctoria), and tall gallberry (Ilex coriacea) mainly during the winter. Of the trees, bays are browsed some during the winter and the gums (Liquidambar styraciflua and Nyssa sylvatica), sourwood (Oxydendrum arboreum), and a few others during early spring. Ordinarily pine trees are not browsed appreciably.

Poisonous plants are responsible for the death of many livestock every year. Some of the more common species of poisonous plants include: Carolina jessamine (Gelsemium sempervirens), lambkill kalmia or wicky (Kalmia angustifolia), and crow-poison (Amianthium muscaetoxicum). In 1943 the North Carolina Agricultural Experiment Station published a bulletin (17) on some stock-poisoning plants of North Carolina, but further studies are needed in the Coastal Plain to determine when and in what abundance they cause trouble, and more about what can be done to control them.

Status of Beef Cattle Industry

Interest in raising beef cattle in the Coastal Plain of North Carolina has increased markedly in recent years as indicated by the increase in number of herds, number of cattle, and improvement in beef type. From 1938 to 1940, for example, the number of herds and cattle nearly doubled, and the number of purebred bulls more than trebled. There has been a somewhat similar expansion in cattle numbers in the Coastal Plain throughout the South and Southeast, amounting to an increase of about 20 per cent in the past 5 years (10). In view of this rapid expansion, the forestry grazing studies should be of considerable value in helping guide the forest and beef cattle programs of many land owners.

The chief factors contributing to the increased interest are:

1. Reduction in cash crop acreages.

2. Increased farm diversification and the realization that an added source of income can be derived from beef cattle by utilizing native forage, and roughage that may otherwise go to waste.

3. More emphasis placed on soil conservation.

4. The need of manure in maintaining soil fertility on the farm.

5. Increase in amount and quality of tame permanent pastures.

6. Increase in production of feed crops.

7. Farm labor difficulties.

8. Relative prices received for beef cattle, feed crops, and cash crops.

9. Increased local demand for beef cattle and beef cattle products and improvement in local marketing facilities.

10. Increase in 4-H Clubs and other extension work.

11. Use of trench silos.

12. Increased demand for beef and hides during the war period.

Hereford breeding by far predominates in the Coastal Plain, although all of the more common breeds are represented. The quality of cattle varies from native to purebreds, but a majority of the farmers seem to realize the value of good animals and are trying to get those best suited to their conditions. The herds vary in size from a few animals up to about 1,000 head.

An average example of year-round management is approximately as follows:

April 15 to November 15:	Ranging in forests and on pastures.
November 15 to January 15:	Gleaning corn stalks and soybean or velvet bean fields.

January 15 to April 15:	Grazing on one or more of the following: rye, oats, barley, wheat, crimson clover, Italian rye grass, vetch.
November 15 to April 15:	Gleanings and grazing supplemented when necessary with some of the following feeds: Peanut straw, soybean hay, lespedeza hay, corn stover, grass hay, silage, cottonseed hulls, corn, cottonseed meal, and soybean meal.

Systems of management vary from ranging cattle on forest areas throughout the year to keeping them entirely on tame permanent pastures and cultivated crops. Based on the survey, forest ranges account for 29 per cent of the year-long sustenance of the animals; tame permanent pastures, 29 per cent; maintenance feeds, 18 per cent; corn stalks, etc., 11 per cent; and small grains, fattening feeds, and summer annuals the remainder. Usually all of these different sources of feed fit well into a year-long program of management. In a few cases farmers have cattle primarily because they have an abundance of wild native forage, but even these generally rely on other sources of feeds for certain seasons of the year. On some farms there is little native forage and this is used only as a supplement to improved permanent and annual pastures.

Twenty-eight per cent of the stockmen finish out some steers, either of their own raising or additional ones purchased. An increasing number of breeders are marketing their cattle chiefly as weaned calves, feeling that it is more profitable to keep larger cow herds and thus sell more calves. This being the case, many beef producers are interested in how to produce the most profitable weaned calves and desire information on the value of supplemental feeding. A study on creep feeding has just been completed and a bulletin covering the results is in preparation.

Less than half of the farmers give their cattle mineral supplements other than salt. Most of those using calcium and phosphorus supplements state that they obtain marked improvements through their use, as indicated by more thrifty condition. Some think that other mineral deficiencies exist in certain localities and a few are now adding iron, copper, and cobalt to the mineral mixtures. Exploratory studies being made on this project indicate that certain of these minerals as supplements improve both the percentage calf crop and the general condition of the animals. Without the supplements, blood analyses showed the hemoglobin content to be low during some seasons of the year. More information and research is needed on

the extent and severity of mineral deficiencies and on methods of correcting them. (In the studies here outlined all groups of cattle, except those in subproject No. 4, will have free access to a mineral mixture composed of calcium, phosphorus, salt, iron, copper, and cobalt. Because there is very little information available for this area regarding mineral deficiencies it is thought advisable to keep this mixture before the animals as a safety measure.)

Tame Permanent Pastures

Tame permanent pastures are an important source of grazing in the Coastal Plain. As stated previously, the survey in 1940-41 showed them to furnish 29 per cent of the year-long sustenance of the animals. The extent of their use is also increasing. This is brought out by the fact that approximately 56 per cent of them were seeded between 1937 and 1941 and at that time there was a considerably larger acreage of planned seeding. Many forest ranges will be used to a greater extent for late fall, winter, and early spring grazing when tame permanent pastures are developed for summer use. At present, lespedeza is the most extensively used pasture plant, furnishing grazing from about the first of June to the first of November. Other important pasture plants are bermuda grass, red top, Dallis grass, blue grass, and white clover. A few open forest areas have been planted to tame pasture grasses.

Tests carried on at the Blackland Branch Station during the past four summers show lespedeza pastures to furnish good grazing during late summer(7). Calves grazed on forest range up until about August 1 and then on lespedeza pasture until weaned about the middle of November averaged 415 pounds in weight whereas those grazed all summer on native range weighed 388 pounds. However, for one summer the calves that grazed all season on native range outweighed those grazed in late summer on lespedeza pasture. This was because the lespedeza pasture was very poor due to severe drought. As a result of the studies extending over four seasons, it was concluded that the use of lespedeza pastures for late summer grazing should be encouraged.

LITERATURE COVERING EXPERIMENTAL WORK ON FOREST GRAZING IN THE SOUTHEASTERN UNITED STATES

Studies of grazing and beef cattle production in the reed or switch cane forage type have been carried on at the Blackland Branch Station in eastern North Carolina for the past 18 years by state agencies, and state and federal agencies cooperating.

Some of the results are reported in publications by Foster, Hostetler, and Case (13) and Hostetler, Foster, and Hankins (16). These studies had to do with beef cattle production in general in the reed forage type, and with the production and quality of meat of native yearling cattle compared with grade yearlings. Reeds were used for about 8 months each year, from about the first of May to the first of January, and represented only 9 per cent of the total cost of keeping a cow through the year. The calves were dropped in February, March, and April, and were also on reed pastures until weaned about November 15. At this time they usually weighed between 350 and 400 pounds. The winter feed cost represented an average of 85 per cent of the total cost of weaned calves.

The calves and yearlings usually made satisfactory gains on the native forage from the time they were turned on the pastures until about the first of August when the rate of gains for the remainder of the season dropped to less than half. The pastures were stocked at an average rate of about 2 acres per animal unit for each season. However, an unpublished analysis made of the rate of stocking of the pastures for 11 years indicates that this rate of stocking (average of 2.1 acres per animal for 11-year period) was too high for sustained yield. At the end of 11 years many of the reeds were killed by heavy grazing and some of the pastures had decreased to about half in grazing capacity. General observations showed that most of the decrease occurred just previous to 1941 when the weather was drier than usual.

The experiments comparing the cost of producing grade versus native cattle showed that the gains of the former were about $1.31 per cwt. cheaper. When the cattle were on reed pastures during the summer the calves from the grade animals gained 0.14 pounds more per head daily than those from the native cattle and weighed 53 pounds more when weaned in November.

The results of a forest grazing survey in Louisiana are reported by Campbell and Rhodes (9), and a survey in the Coastal Plain of Georgia are reported by Biswell, Southwell, Stevenson, and Shepherd (4). Forest lands in Louisiana and Georgia contribute a large percentage of the yearlong sustenance of beef cattle in both of these states. However, the calf crops are generally low, ranging from about 30 per cent to 85 per cent, and many farmers are not getting as good returns from their cow herds as they should. There are several problems in forest range grazing and beef cattle management on which more information is needed, the chief of which are: 1, development of practices that will result in more profitable use of the forest range each year and thereby reduce the wintering costs; 2, correlation of improved permanent pastures and forest

ranges; 3, fire hazard reduction, and development of improved practices in prescribed burning to improve the forage for grazing; 4, determination of the grazing capacity of different types of forest range for sustained yield, and the effect of different intensities of grazing on tree reproduction and growth and on cattle gains; and 5, the kinds and extent of any mineral deficiencies and means, costs, and values of correcting them.

Studies by Biswell et al. in the Coastal Plain of Georgia (5), and by Biswell et al. in the Coastal Plain of North Carolina (6) show that the native forage is deficient in protein, calcium, and phosphorus during the winter months. When cattle are on range during the winter they need protein supplements to make up for this deficiency. Mineral supplements are needed year-long.

Studies on the digestibility of reeds by Blackmon (8) showed that the digestible nutrients furnished to cattle that are grazing good reeds in June ranges from 52.2 to 57.6 pounds per 100 pounds of reeds consumed on a moisture free basis, averaging 55.05 for four sets of data. On a green weight basis, this places the T.D.N. value at 12.42 pounds per hundred-weight. This means that the T.D.N. of reeds compares very favorably with that of other green feeds.

Wahlenberg, Greene, and Reed (18), working in Mississippi, report the effects of four land treatments -- burned pasture, unburned pasture, burned ungrazed, and unburned ungrazed -- on the use of longleaf pine land for cattle grazing as well as for timber production. They found that annual winter burning of uncontrolled intensity retarded the growth of longleaf pine sapling trees by about one-fifth in diameter and one-fourth in height during a 5-year period. The survival of seedlings after 10 years following a good seed crop, was 43 per cent on the unburned, ungrazed area as against not over 5 per cent for any one of the other three land treatments. However, because of the brown spot needle disease, none of the treatments were successful in bringing new longleaf pine seedlings out of the grass stage. During this time both the growth and cone production of older trees apparently was little affected.

Annual winter burning of uncontrolled intensity in the "wiregrass" type maintained more favorable composition, quality, and quantity of forage than did exclusion of fires. This was reflected in the greater seasonal gains in weight of cattle on the burned area. The authors concluded that while annual winter fires of uncontrolled intensity improved the forage conditions for cattle, the results indicate that successful regeneration of longleaf pine may depend upon some system of periodic controlled burning rather than the extremes of annual fires of uncontrolled intensity or fire

exclusion, both found by this study to be unsatisfactory. Burning and grazing did not result in serious soil degradation. The burned-over soils exhibited slightly favorable chemical characteristics and unfavorable physical characteristics in comparison with unburned soils, although none of these changes appeared to be of any practical significance. The net effect on plant growth of these soil changes was not measured.

Animal nutrition studies by Becker, Neal, and Shealy (1, 2) in Florida show that animals on open range may be in poor condition because of mineral deficiencies in the native forage and that by supplying proper minerals their condition may be improved.

Wahlenberg, Greene, and Reed (18) present a rather thorough review of world literature pertaining to forest grazing and burning in other places.

FOREST RANGE GRAZING PROBLEMS

Many problems and questions about effective forest range grazing need research, as was revealed by: 1, farmers interviewed in a survey; 2, experimental work already done in this area; 3, general observations; 4, discussions with persons interested in land-use problems; and 5, literature on this subject. The chief of these problems are:

1. To determine the sustained grazing capacity of the different types of forest range, especially the reed or switch cane type which seems to be very sensitive to heavy grazing.

2. To determine the effects of different degrees, seasons, and systems of grazing on the forage and on cattle gains, and on tree reproduction and growth.

3. To determine the value of grazing in reducing the forest fire hazard.

4. To determine the value of supplementary feeding of different classes of animals on the forest range at different seasons of the year, including different planes of nutrition, and of providing supplemental pastures for late summer grazing. Also, studies are needed to determine the practicability of finishing yearling steers completely or partially on forest range.

5. To determine the need for mineral supplements of different kinds on forest ranges and the value of correcting any deficiencies.

6. To determine the effect of having the cows breed either earlier or later than in the present practice, and the effect upon beef production of breeding heifers to calve the first time as two-year-olds as compared to calving the first time as three-year-olds.

7. To determine more fully the kinds of poisonous plants, their distribution, abundance, poisonous properties, effect on beef production, method of control, and economic importance on the forest range.

Obviously a research program can not effectively cover all these at any one time, or perhaps all the different phases of a single problem. Therefore, it is necessary to select the problems of greatest importance and first tackle those phases which it is thought will yield the greatest and quickest returns to the farmer. In selecting these, it is necessary to give consideration to both efficient cattle production and efficient timber production if the most is to be obtained from the land.

Research studies may eventually indicate when and under what conditions either of these should be given primary consideration. In fitting these uses together some practices that may be beneficial to one, may to some extent, of course, be detrimental to the other.

SELECTION OF FORAGE TYPE AND LOCATION OF STUDIES

The studies have been mainly in the reed forage type and it is thought they should be continued here for the following reasons:

1. It is one of the largest forage types in the Coastal Plain.

2. It is most extensively used for cattle grazing at present.

3. The possibilities for expanding cattle grazing appear to be greatest in this type.

One of the work centers is at the Hofmann Forest in the southeastern section of the Coastal Plain, and the other is at the Blackland Branch Station in the northeastern section of the Coastal Plain. The forage at the Hofmann Forest is mainly of reeds, although a great combination of herbaceous and browse plants, and different types of forage occur here. Parts of the forest are typical of the wiregrass type. The forest grazing land at the Blackland Branch Station, largely muck soil, was drained and logged several years ago and since then has burned over so frequently that practically no trees survive. The forage is mainly of reeds. However, in spring and early summer, warty panicum (Panicum verrucosum) provides considerable forage. Other species appear to be of minor importance. Until fires are controlled, grazing will represent the main source of income from this land.

Although the Blackland Branch Station was sold, and replaced by the Tidewater Branch Station, in 1944, it has been decided to carry on with studies there in the reed areas for the next three years. This should give time to plan and make developments for studies at the Tidewater Branch Station. The reed areas at the Blackland Branch Station are on leased land and were not sold, of course. No more fences will be needed to continue the studies for another three years. Some of the cattle will probably be moved to the Tidewater Branch Station for wintering and then moved back to the reed areas for summer grazing. The cattle can be driven along an old railroadbed from the reed areas to the Tidewater Branch Station, a distance of 5 or 6 miles.

PROBLEMS OR PHASES OF PROBLEMS SELECTED FOR STUDY
(Line Project)

The problems or phases of problems selected for study all have to do with finding the most practical systems for utilizing the reed forage type by beef cattle. Four of the subprojects listed below were outlined in the revised working plan of June 1942. The other four are new subprojects. The subprojects that have been closed out, or completed, since the working plan of June, 1942, are listed further on in this working plan; each is discussed briefly.

(Subprojects)

Subprojects selected for study at present, are:

1. Effects of heavy grazing and moderate grazing on reeds and on cattle gains at Wenona (new subproject).

2. Use of reeds in finishing yearling steers (new subproject).

3. Logging effects and degree of grazing (old subproject, No. 3).

4. Mineral requirements on forest range (new subproject, largely under supervision of Animal Nutrition Division, A. H. Department, North Carolina State College).

5. Different planes of nutrition for wintering breeding cows on forest range (old subproject, No. 5).

6. Wintering calves on reeds (old subproject, No. 6).

7. Relative grazing values and nutritive properties of forage plants as shown by chemical analyses (old subproject, No. 7).

8. Development of beef cattle especially adapted to the Coastal Plain region of North Carolina (new subproject, largely under supervision of Animal Husbandry Department, North Carolina State College).

OUTLINE OF FOREST GRAZING PROJECT PROGRAM

This section presents the following information about each of the subprojects selected for study:

Purpose
Importance of study
Status
Methods
  Field procedure and records
  Statistical analysis
Duration

Certain parts of the methods section will be expanded in more detail as the work develops.

Effects of Heavy Grazing and Moderate Grazing on Reeds and on Cattle Gains at Wenona

(Subproject No. 1)

Purpose:

To find the effects of heavy and moderate grazing on dense vigorous reeds and on cattle gains, and to develop "yard-sticks" for judging utilization (to be done at the Blackland Branch Station).

Importance of Study:

Studies of the effects of two degrees of grazing on logged and unlogged areas are already in progress at the Hofmann Forest. However, properly stocking reed areas to prevent over grazing and killing the reeds and to produce maximum cattle gains is one of the biggest problems in their proper management. Additional studies are needed at the Blackland Branch Station, therefore, where the reeds are of higher grazing value than those at the Hofmann Forest. Previous studies have shown that reeds are easily killed if over grazed during the summer but more information is needed on optimum rate of stocking for maintaining vigor in reeds and for best cattle gains. If "yard-sticks" can be developed whereby the proper use of reeds can be determined in different types of stands it will be possible to avoid overgrazing, killing the reeds, and destroying the grazing capacity of forage ranges.

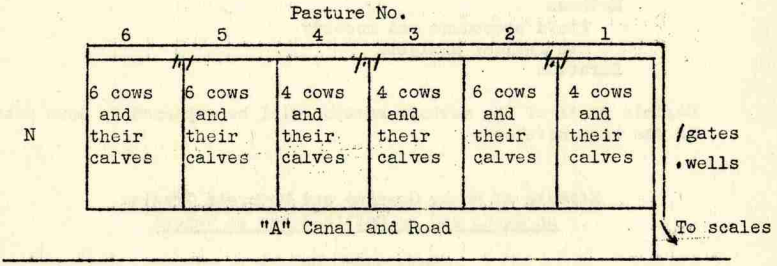
Status:

This is a new subproject.

Methods:

Field Procedure and Records:

1. The six 15-acre steer pastures that were used in the rotation grazing subproject (closed out) will be used for this study. The treatments will be run in triplicate as indicated by the number of animals in each pasture in the following figure:



The forage in these pastures was not changed appreciably as a result of previous use in the rotation grazing experiment. However, a fire burned the muck soil in the end of some of the pastures so that two of them appeared better than the others. In addition, two of the remaining four pastures were also slightly better than the two poorest ones. As a result of these differences the pastures were grouped by two's and the treatments assigned at random.

2. Divide 30 cows and their calves into uniform groups (numbers indicated in figure above) about May 15 and graze them on pastures until about November 15. (The calves from this subproject will be used in subproject No. 6 - Wintering Calves on Reeds.)

3. At the beginning and close of each grazing season, the animals will be graded by a committee. The cows will also be graded according to condition and vigor, and the calves appraised. All cattle will be weighed individually at the beginning and close of a test and at 28-day intervals during a grazing period. The initial and final weights used will be, where practical, the average of those taken on three consecutive days at the beginning and close of a grazing season.

4. Pictures will be taken of typical animals in the various treatments at the beginning and the close of each grazing season.

5. The forage in each pasture will be sampled (4 plots per pasture) at the beginning and end of each grazing season for composition, density, and vigor. Degree of forage utilization will be measured at the close of each grazing season.

6. General observations of utilization, and stage of growth of the important species will be made and recorded each 28-day weigh period, with any other general notes of differences between pastures or groups.

Statistical Analysis:

CATTLE (for one year)		FORAGE (for one year)	
Source of variation	d.f.	Source of variation	d.f.
Intensity	1	Intensity	1
Replications	2	Replications	2
Replication x intensity	2	Replications x intensity	2
Cows in groups	24	Plot locations	18
Total	29	Total	23

Duration:

It is planned to begin this subproject in May 1945 and continue it at least three full seasons.

Use of Reeds in Finishing Yearling Steers

(Subproject No. 2)

Purpose:

To determine the practicability of finishing yearling steers completely or partially on reed areas by the addition of concentrated supplemental feeds after August 1, rather than finishing entirely in the dry lot (to be done at the Blackland Branch Station).

Importance of Study:

Finishing yearling steers in the dry lot after about November 15 on corn, soybean hay, and cottonseed meal has proved to be rather expensive. It is quite possible that it would be cheaper and more practical to finish or partially finish yearling steers by feeding them concentrated supplemental feeds on reed areas where there is an abundance of forage.

Status:

This is a new subproject.

Methods:

Field Procedure and Records.

1. The areas used in the creep feeding subproject (closed out) and those used for the heifers in the rotation grazing subproject (also closed out) at the Blackland Branch Station will be used for this study. The steers will be shifted among the areas so that plenty of forage will always be available, and in such a way as to alleviate pasture differences.

2. Graze 30 steers together on reed areas from about May 15 to about August 1 and then divide them into three uniform groups and graze and feed as follows:

   Group 1

   Graze 10 steers on reed areas from about August 1 to

November 15 and then finish them out in the dry lot on shelled corn and shredded corn stover full fed, cottonseed meal 2 pounds per head daily, and soybean hay 5 pounds per head daily. This procedure has been carried on for several years at the Blackland Branch Station, and the results for 1941-42, 1942-43, and 1943-44 have been written up and published (14). The 1944-45 group completes another finishing trial in April 1945. This group of steers will serve as a check on the other two.

Group 2

Finish out 10 steers on reed areas after about August 1 by full feeding them a concentrated supplement of 5 pounds of cottonseed meal per head daily and a full feeding of ground corn.

Group 3

Finish out 10 steers on reed areas and in the dry lot by feeding them the same as group 2 from about August 1 to November 15 and then handling and feeding them the same as group 1 until they are finished.

3. All steers will be weighed individually at the beginning and end of each trial and at 28-day intervals. Where practical the initial and final weights used will be the average of those taken on three consecutive days at the start and close of each trial. Each animal will be graded according to the U. S. Grading System by a committee about August 1 and again when finished. Additional grades will be taken when the steers in groups 1 and 3 are put in dry lot.

4. Daily feed records as well as complete cost records and financial returns of the different methods of handling the groups will be kept throughout the period. Pictures of representative animals will be made about August 1, about November 15, and at the end of the finishing periods.

5. Every 28 days (weigh periods) measurements will be made of degree of grazing, kinds and amounts of forage available, and observations of cattle condition.

Statistical Analysis.

CATTLE (for one year)

Source of variation	d.f.
Between groups	2
Steers in groups	N - 3
Total	N - 1

Duration:

It is planned to begin this subproject in May 1945 and continue it for at least three full seasons.

Logging Effects and Degree of Grazing

(Subproject No. 3)

Purpose:

To find the effects of cattle grazing on tree reproduction following logging, and the effects of logging and degree of use on grazing capacity (in progress at the Hofmann Forest).

Importance of Study:

There has been considerable question among foresters and cattle producers as to whether grazing in this forage type is beneficial or detrimental to tree reproduction. On this hinges largely the practicability and economics of the multiple use of forest lands for timber growing and cattle raising. Some land managers claim that cattle grazing in this forage and forest type will destroy seedlings and young trees while others maintain that it keeps down some of the undergrowth and by doing this, tree reproduction is favored. More information is definitely needed on this question before forest grazing in this type can be fully and properly evaluated.

In order to make proper adjustments in cattle numbers following timber cutting operations it is desirable to determine how the grazing capacity and rate of animal gain is affected by logging.

Status:

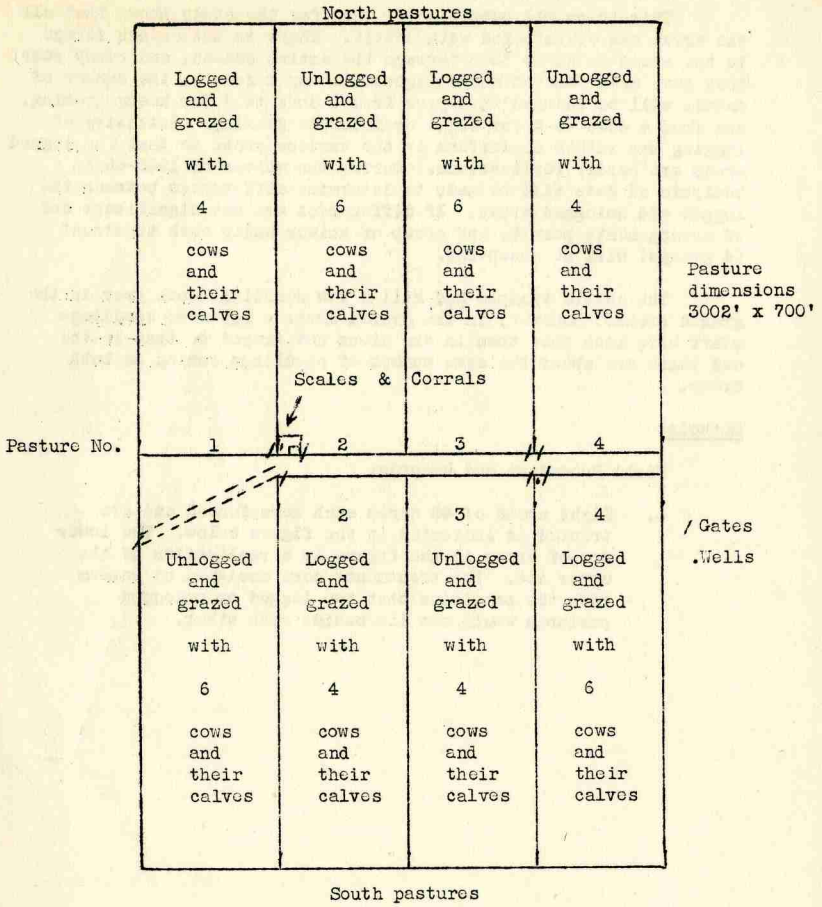
This is an old subproject. Thus far the study shows that all the areas are overstocked with cattle. There is not enough forage in the areas to carry them through the entire season, and every year they have been removed about August 15. As a result, the number of cattle will be reduced this year from 9 down to 6 for heavy grazing, and from 6 down to 4 for light or moderate grazing. Intensity of logging was rather un-uniform in the various areas so that the logged areas are hardly replications. During the winter of 1945-46 an analysis of data will be made to determine differences between the logged and unlogged areas. If differences are not significant and if arrangements permit, one group of calves under each treatment (4 groups) will be creep-fed.

The cattle trample and kill a few seedlings each year in the grazed areas. However, in the grazed areas a few more seedlings start here each year than in the areas not grazed so that in the end there are about the same number of seedlings coming on both areas.

Methods:

Field Procedure and Records:

1. Eight areas of 48 acres each were fenced and are treated as indicated in the figure below. The lower set of areas in the figure is a replication of the upper set. The treatments were assigned at random with the provision that two logged or unlogged pastures would not lie beside each other.


North pastures
Logged and grazed with 4 cows and their calves
Unlogged and grazed with 6 cows and their calves
Logged and grazed with 6 cows and their calves
Unlogged and grazed with 4 cows and their calves
Scales & Corrals
Pasture No.
1
2
3
4
Pasture dimensions 3002' x 700'
/ Gates
.Wells
1
2
3
4
Unlogged and grazed with 6 cows and their calves
Logged and grazed with 4 cows and their calves
Unlogged and grazed with 4 cows and their calves
Logged and grazed with 6 cows and their calves
South pastures

2. Forty cows and their calves are divided into uniform groups (numbers indicated in figure) about May 1 and grazed on the areas until about August 15. When the cows come off of this experiment each year they are placed together in a pasture until started on subproject No. 5, (different planes of nutrition for wintering breeding cows on forest range). About November 15 the calves are weaned. The steers are moved to Raleigh for finishing tests and the heifers are kept at the Forest for replacement and to build up the number of cattle on the Forest.

3. At the beginning and close of each grazing season, the animals are graded by a committee. The cows are also graded according to condition and vigor, and the calves are appraised. All cattle are weighed individually at the beginning and close of a test and at 28-day intervals during a grazing period. The initial and final weights used are, where practical, the average of those taken on three consecutive days at the beginning and close of a grazing season.

4. Group pictures of the cattle are taken when needed in each of the four treatments to show any differences.

5. One square plot, 1/4 acre in area, was placed at random in each one-fourth section of an area and staked. Another plot was paired with each of these and fenced, making a total of four unfenced and four fenced plots in each area. The unfenced plots are at least one chain from those fenced.

6. In each unfenced and fenced area, two plots 66 x 3.3 feet in size were placed at random (border strip within each unfenced or fenced enclosure of about 10 feet), on which the following measurements are made: (The initial measurements were made in the fall of 1942 before any grazing was started).

   a. All tree seedlings are counted and height measured; if above breast high, diameter at this level instead of height is measured.

   b. Density and composition of other plants on the plots are estimated and height measurements taken.

c. Vigor is estimated.

d. Degree of utilization is estimated.

e. Any tree grazing or other damage done by the cattle is noted and recorded.

Similar measurements are made at the close of each grazing season. Thus far, they have been made each year.

7. In each fenced and unfenced area it is planned to make clippings each fall to determine the difference in amount of fuel on the grazed and ungrazed plots, as a possible indicator of fire hazard reduction. Thus far, two sets of clippings have been made.

8. General observations of utilization and stage of growth of the important species are made and recorded each 28-day weigh period with any other general notes of differences between pastures or groups.

9. A permanent photo-station was established on each of the fence lines separating the pastures and pictures were made before any grazing was started. Pictures are made at the close of each grazing season. Another station was established on the boundary of one of the fenced enclosures in each of the areas. A picture was made here also before any grazing was started, and one is made at the end of each grazing season.

Statistical Analysis.

CATTLE (for one year)

Source of variation	d.f.
Replication	1
Logging	1)
Intensity	1)
L x I	1)
Rep. x Main effects	3
Animals in groups	N-8
Total	N-1

FORAGE (for one year)

Source of variation	d.f.
Replication	1
Logging	1)
Intensity	1)
L x I	1)
Error (a)	3
Location in plot	24
Treat (grazing)	1)
T x L	1)
T x I	1)
T x L x I	1)
Error (b)	4
Treat x location in plot	24
Sampling error	64
Total	127

For such variables as amount of forage removed by grazing, which is measured by the difference between the fenced and unfenced plots, only the first half of the forage analysis is applicable.

Duration:

This experiment should be continued for a period of at least 10 years. The fencing and logging was started in the fall of 1941 but the grazing was not started until 1943. Two trials have now been completed (March 1945). As stated in the Status of this subproject, the logged pastures may be used later in a study of creep feeding.

Mineral Requirements on Forest Range

(Subproject No. 4, largely under supervision of Animal Nutrition Division, A. H. Department, North Carolina State College)

Purpose:

To study the effects of the absence of different minerals in a mixture on growth and reproduction of cattle on forest range. (This is largely an exploratory study).

Importance of Study:

The native forage is deficient in calcium and phosphorus and perhaps in some of the rare mineral elements. In many places the percentage calf crop is low and the cattle do not do as well as expected. It is possible that this is partly due to some mineral deficiency that we know very little or nothing about at present. If so, it is possible that this deficiency might be corrected at little cost and be of great economical value.

Status:

This subproject was started in 1937. When the cows were first moved to the Hofmann Forest preliminary results with feeding cobalt indicated that when this was added to a mineral mixture the cows did better and the percentage calf crop was increased. However, present studies are indicating that the addition of cobalt in the mineral ration has no noticeable effect on the heifers.

Methods:

Field Procedure and Records.

1. Thirty yearling heifers that had been born and raised on forest range at the Hofmann Forest were divided into two uniform groups June 3, 1943. They were given access to mineral mixtures, in addition to salt, as follows:

Group 1

Steamed bonemeal 80 % and salt 20%

Group 2

Steamed bonemeal 80%, salt 19.95%, and cobalt carborate .05%

2. A range area of approximately 1200 acres containing scattered reeds, woods grasses, and browse is used in this experiment. It had been fenced for a few years but a division fence was put in to divide the area as equally as possible in acreage and types of forage.

3. All cattle are weighed at the beginning and close of each supplemental feeding period, and on about August 1 at the close of the breeding season. The animals are graded at the start and close of each summer grazing season and are also scored according to condition and vigor. The calves are to be graded at the start of the grazing season, and graded and appraised when weaned about November 15.

4. The heifers are left in the same range area throughout the test. The winter after they were yearlings they received two pounds of cottonseed meal per head daily from December 17 to April 20. The second winter the supplemental feeding consisted of 4 pounds of cottonseed meal per head daily and was started on January 3. They were with bulls from April 20 to August 17, 1944.

5. Blood samples for analysis were taken at the start of the trial and at the beginning and close of the supplemental feeding period for the first year. Other blood samples will be taken whenever it is deemed worthwhile. The breeding season will extend from about May 1 to August 1.

6. Observations of the animals are made every 28 days to note any differences if they appear.

7. Pictures of representative animals in each group are taken when needed to show effects of the treatments.

8. The calves will be removed from the areas when weaned in November.

Statistical Analysis:

CATTLE (for one year)	d.f.
Source of variation	
Between Groups	1
Animals in Groups	N-2
Total	N-1

Duration:

This exploratory study will extend over a period of at least three more years. After that it is possible that a more detailed study will be outlined.

Different Planes of Nutrition for Wintering Breeding Cows on Forest Range

(Subproject No. 5)

Purpose:

To study the relative value of different planes of nutrition for wintering breeding cows on forest land, and the effects of winter grazing on the forage and on tree reproduction (in progress at the Hofmann Forest).

Importance of Study:

Forest lands, especially those containing thick and protected stands of reeds, furnish much winter feed. Some cattlemen rely on forest range entirely for wintering their cows, while others supplement this with varying amounts of harvested feeds. Where no supplements are fed, the calf crops are very low and usually death losses are high, but the most profitable plane of nutrition to winter the cows needs investigating. Work will also be needed later to determine this for different ages and classes of cattle as well as

for cows. To fully evaluate forest grazing, studies are needed to determine the effect of winter grazing on the forage and on the trees, and to find how the grazing capacity for this season of year compares with that during the summer.

Status:

This is an old subproject. Studies are showing that the cows wintered on the higher planes of nutrition come through the winter in the best condition and produce the highest percentage calf crop. Death losses are also lowest in the herds fed at the higher levels. An article covering the results of this subproject has been published in the Journal of Animal Science (15).

Methods:

Field Procedure and Records.

1. The cows used in subproject No. 3 (Logging Effects and Degree of Grazing), plus about 60 cows held in reserve are divided into three uniform groups about January 1 (earlier if the animals begin to lose weight) and are wintered as follows:

Group 1

Thirty or more animals are grazed on reeds and supplemented with 2 pounds of cottonseed meal per head daily.

Group 2

Thirty or more animals are grazed on reeds and supplemented with 4 pounds of cottonseed meal per head daily.

Group 3

Thirty or more animals are grazed on reeds and supplemented with 6 pounds of cottonseed meal per head daily.

Three range areas of 1000 to 1200 acres each containing scattered reeds are used in this experiment (these were fenced several years ago but are proving to be suitable for this subproject). The three groups of cattle are shifted among the pastures every 28 days to lessen any pasture differences. The pasture layout and shifting arrangements are as follows:

	A	B	C
1st 28 days	1	2	3
2nd 28 days	3	1	2
3rd 28 days	2	3	1
4th 28 days	1	2	3
5th 28 days	3	1	2
etc.			

A, B, C. - Pastures
1, 2, 3. - Cattle groups

2. All cattle are weighed individually at the beginning and close of each test and at 28-day intervals. The initial and final weights used are, where practical to weigh three times, the average of weights taken on three consecutive days at the beginning and close of a test. The cows are graded by a committee at the start and close of a test and are also scored according to condition and vigor. At the close of a trial the calves are appraised and graded.

3. Daily feed records of the cattle are kept throughout the period as well as complete cost records and financial returns of the different methods of handling the groups. Records kept for experiment No. 3 (Logging Effects and Degree of Grazing) show the effect of condition of wintering on summer gains.

4. Pictures of representative animals in each group are taken when needed to show the effects of the treatments.

5. Observations are made in the areas every 28 days to note any differences in utilization, feed available, and to record the stage of development of the important species.

6. Measurements will be made each winter (new phase of the study) to determine the amount of damage done to pine tree seedlings and saplings.

Statistical Analysis.

CATTLE (for one year)

Source of variation	d.f.
Between groups	2
Cows in groups	N-3
Total	N-1

Duration:

With variations in supplemental feeding the general plan of this subproject will probably continue for about 10 years. This study was started in the winter of 1941-42. The fourth test will be completed about May 1, 1945.

Wintering Calves on Reeds

(Subproject No. 6)

Purpose:

To compare wintering weaned calves in reed areas to wintering on the farm. (This is being done at the Blackland Branch Station).

Importance of Study:

Wintering of cattle on the farm is the most expensive period of any season of the year. Where reed forage is available, the studies are showing that through supplemental feeding on the range, the cost of wintering can be greatly reduced.

Status:

This is an old subproject. Thus far the study shows that weaned calves can be wintered satisfactorily on reed range when the forage is supplemented with two or four pounds of cottonseed meal per head daily. During mild winters, when the reed leaves do not shed so badly as a result of frosts, the calves do better than they do during "cold" winters. During the winters of 1941 and 1943 the calves were not wintered on reeds because of fires that destroyed the forage.

Methods:

Field Procedure and Records.

1. Calves from subproject No. 1 (Effect of Heavy Grazing and Moderate Grazing on Reeds and on Cattle Gains at the Blackland Branch Station) and from cows in the reserve group are divided into four equal groups at weaning time. The groups will each consist of 10 calves or more.

   Groups 1 and 2

   These calves are wintered on the farm much as in former years on the Blackland Branch Station, namely; corn stalk and soybean field gleanings and winter pasture supplemented with corn stover and soybean hay when sufficient forage is not available. In addition, approximately 2 pounds of concentrates are fed per head daily. When winter pasture is available, Group 1 is grazed on Abruzzi Rye and Group 2 on Italian Rye grass. Therefore, the only difference in the treatment of Groups 1 and 2 is in the kind of winter pasture. These winter pastures are approximately 10 acres each and are seeded early. When tests by the Agronomy Department of North Carolina State College indicate that other pasture crops may be better suited for winter grazing, they will be substituted for the ones used in this test.

   Groups 3 and 4

   These calves are grazed on reeds; Group 3 supplemented with 2 pounds of cottonseed meal per head daily and Group 4 with 4 pounds. Abundant feed forage is provided in pastures already fenced, but the groups are alternated between these two pastures every weigh day to lessen the effects of any pasture differences.

2. All cattle are weighed individually at the beginning and close of each test and at 28-day intervals during the grazing period. The initial and final weights used are, where practical, the average of weights taken on three consecutive days at the beginning and close of each test. Each animal is also graded according to the U. S. Grading System by a committee at the start and close of each test.

3. Daily feed records of the cattle are kept throughout the period as well as complete cost records and financial returns of the different methods of handling the groups.

4. Group pictures of the cattle are made when desirable to show any results of different wintering treatments.

5. At the end of every 28-day period, the reed pastures are observed and a record made of the degree and uniformity of utilization and condition of the forage. The cattle will also be observed each time to find the forage species grazed and the portions of plants consumed.

Statistical Analysis.

CATTLE (for one year)

Source of variation	d.f.
Between groups (Reeds vs. Farm Gleanings 1)	3
Animals in groups	N-4
Total	N-1

(At the close of this test, the steers will be used in subproject No. 2, Use of reeds in Finishing Yearling Steers.)

Duration:

This experiment should be continued through at least 3 full seasons. The pastures were burned over in the falls of 1941 and 1943 which delayed progress on the experiment. At the end of this season (1945), however, two trials will have been completed.

Relative Grazing Values and Nutritive Properties of Forage

(Subproject No. 7)

Purpose:

To study utilization, palatability, and value of forage plants for grazing (being done at the Blackland Branch Station and the Hofmann Forest).

Importance of Study:

To manage properly any grazing area, it is necessary to know the plants that furnish the bulk of the forage at different seasons of the year, and something of their palatability and nutritive values.

This type of data is necessary for determining such things as grazing capacity, season of most profitable use, and kinds and amounts of supplements needed.

Status:

This is an old subproject. One bulletin on this subject is now in print -- "Native Forage Plants; species utilized by beef cattle in the North Carolina Coastal Plain". Another bulletin, "Chemistry of Southeastern Native Range Plants", is being prepared by Mr. Boggess, for U. S. Department of Agriculture publication. The first draft of this should be completed in the fall of 1945. A thesis on the digestibility of reeds was prepared by Mr. Bruce Blackmon. This was covered in the review of literature.

Methods:

Field Procedure and Records:

1. Cows on pastures in the subprojects already outlined at the Blackland Branch Station and at the Hofmann Forest have been followed systematically and forage samples representative of their diet collected. These were sent to the laboratory for chemical analysis. Notes were taken of the following:

    a. Percentage of each species in the diet.

    b. Portions of plants grazed.

    c. Grazing habits.

        1. Time of day grazing is done.
        2. Type of grass grazed.

    d. Approximate composition of the plants making up the vegetation cover in the areas grazed.

2. Pure samples of two or three of the most important species were also collected for chemical analysis. These were made throughout the year when the animals were grazing on forest range.

Statistical Analysis.

It is believed that a statistical analysis of most of these data are not necessary in view of the type of comparisons made. As the work develops, however, it may become advisable to develop a program of statistical analysis.

Duration:

Most of the collections for forage analyses have been made (March 1945). However, general observations of grazing will continue as long as there are experiments at the Hofmann Forest and the Blackland Branch Station.

Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina

(Subproject No. 8, largely under supervision of Animal Husbandry Department, North Carolina State College).

Purpose:

To learn whether beef cattle resulting from crossing grade Hereford cows to Brahman and Africander bulls are more productive in the Coastal Plain (particularly for reed grazing) than a high grade of Herefords. Also if the cross-breds are more productive, efforts will be made to develop a relatively pure breeding strain from one or both of the crossbred groups.

Importance of Study:

It is well known that the British breeds of beef cattle do not perform as satisfactorily as Brahman or Africanders in tropical or sub-tropical climates. Crosses of the common beef breeds with either the Brahman or the Africanders also perform better in such climates than do the British breeds.

It is desirable to know what kind of cattle are most productive in the Coastal Plain and in particular whether cattle carrying Brahman or Africander blood will show the same advantage demonstrated in slightly more extreme (tropical) climates. If they are better by even a portion of the amount by which they excel the British breeds in some other portions of the United States, their use in this area would be of tremendous economic importance.

Status:

This project was started in 1944.

Methods:

Field Procedure and Records.

The female foundation stock will be comprised of the overflow females from the grade Hereford herd at the Hofmann Forest. About 30 were available in the spring of 1944; equal numbers were bred to Africander and Brahman bulls. About 60 cows and heifers will be available for this purpose in the spring of 1945. The same use will be made of all overflow Hereford females for as many years as the production of F_1's is required. Since grade Hereford calves are produced at the Forest every year, the two crossbred groups can be compared to them as well as to each other.

The Crossbred calves and their dams will be grazed in the same pastures as Hereford calves and their dams. Thus a fair comparison can be made each year. The number of pastures used will probably change from year to year.

All F_1 females, excepting those decidedly inferior, will be retained for breeding. They will be bred as two-year-olds to bulls of their own F_1 group. Intense selection based on growth rate, conformation, vigor, temperament and mothering ability will be practiced starting with the F_2 generation. Both the records of individuals and of their progeny when available will be considered.

If sufficient animals satisfactory in conformation do not appear in generations following the F_2 some females will be bred to Hereford bulls that are superior in beef type. The extent of such matings cannot be forecast.

The data to be recorded are as follows:

1. On calves

   a. At birth or shortly after--date of birth, sex, weight (if practical), and color.

   b. At weaning--weight, conformation, condition, and color.

   c. At beginning and end of each grazing season until maturity (for those retained)--weight and conformation.

2. On cows--weight and condition at or shortly after calving and at weaning time. Conformation will be recorded at weaning time.

3. On bulls--weight, condition and conformation at beginning of breeding season; and per cent of cows bred that conceived.

4. On all animals--pedigrees and coefficients of inbreeding; and all unusual characteristics of a specific nature.

These records will be supplemented by suitable pictures.

Conformation and finish will be scored on numerical scales. Conformation scores shall be based on (a) compactness, (b) loin, (c) quarter will be evaluated considering levelness of rump as well as fullness and depth of the entire rear quarters, and (d) thrift. Notes will be made of outstanding faults.

Periodic slaughter tests will be made to check on carcass quality. Whenever possible rate of gain and efficiency of food utilization of steers of the new strains and of Hereford steers will be compared within the structure of nutrition experiments.

Statistical Analysis:

CATTLE (for one year)

Source of variation	d.f.
Type of breeding	2
Pastures	p-1
Calves of same breeding in same pasture	N-p-2
Total	N - 1

Weaning weight of calves will be adjusted for age by Covariance. Comparisons of the productivity of F_1 and Hereford females will not be possible until 1948 or 1949 at the earliest.

Duration:

Thirty years unless it is decided neither cross has sufficient merit to justify carrying on with it.

Subprojects Completed or Closed Out

Since the June 20, 1942 revision of the project analysis and working plans was written two subprojects have been completed and another closed out. These are as follows:

1. Rotation Grazing on Forest Range (old subproject No. 1). The purpose of this subproject was to compare the practice of continuous grazing of the reed forage type with the practice of rotating one time at mid-season and with rotating every 28 days. This subproject was carried through three full seasons and one short season. This experiment was done at the Blackland Branch Station.

The results of this subproject will be prepared in bulletin form in 1946 for publication by the North Carolina Agricultural Experiment Station.

2. Creep Feeding Nursing Calves on Forest Range (old subproject No. 2). The purpose of this experiment was to determine the value of creep feeding nursing calves on reed pastures to weaning age, and to compare this with the value of running calves on reed pastures in the early part of the season and then transferring them to lespedeza pasture until weaned. This experiment was carried on at the Blackland Branch Station, through three full seasons and one short season.

The results of this subproject will be prepared in bulletin form in 1945 for publication by the North Carolina Agricultural Experiment Station.

3. Effect of Two Rates of Grazing on Burned and Unburned Areas (old subproject No. 4). The purpose of this subproject was to find the effect on reeds of two rates of grazing on both burned and unburned areas. This experiment was carried on at the Blackland Branch Station for one year, but then an accidental fire (not in connection with this experiment, however) burned the muck soil to a depth of about 18 inches and it was necessary to close out the experiment. Results of one year, however, supplemented with general observations, show that it is not advisable to burn reed areas for several reasons: First, burning delays the grazing season from 1 to 4 weeks because new reeds are very easily damaged, even by light grazing; therefore, it is necessary to keep the cattle off of them until they are about 30 inches tall. Second, the foliage produced after a fire has low frost resistance the following fall and the leaves drop earlier than on unburned areas. Third, the amount of reed forage available during the first growing season after a fire is

less than on unburned areas and a larger acreage is needed for each animal. Fourth, it is not only difficult but usually impossible to control reed fires, because of their speed and severity. The results are included in the bulletin, "Native Forage Plants; Species utilized by Beef Cattle on Forest Range in the North Carolina Coastal Plain".

PREPARATION OF REPORTS

Brief progress reports covering each subproject are prepared annually. About every 3 years bulletins will be published covering the work completed up to that time. These bulletins may be on individual subprojects or may cover two or more subprojects combined. For subprojects of longer duration publications in the form of progress reports will also be prepared about every 3 years.

Subprojects that should yield enough worthwhile information to justify publications at the end of three complete trials are as follows:

(Subproject No.)

1. Effect of heavy grazing and moderate grazing on reeds and on cattle gains at the Blackland Branch Station.

2. Use of reeds in finishing yearling steers.

3. Logging effects and degree of grazing.

5. Different planes of nutrition for wintering breeding cows on forest range.

6. Wintering calves on reeds.

7. Relative grazing values and nutritive properties of forage (one bulletin in hands of printer, another being prepared).

Technical or popular articles may be prepared covering certain phases of this work whenever it is deemed desirable.

All compilations and publications of these data will be performed jointly by representatives of the cooperating agencies.

RESPONSIBILITY

H. H. Biswell will be directly responsible for the technical supervision of the forestry and forage phases, and J. E. Foster for the animal husbandry phases. The forestry and animal husbandry technicians will have immediate direction of the field work. All statistical analyses will be under the supervision of the Department of Experimental Statistics, North Carolina Experiment Station. All major changes in the program and publications will be considered and approved by the directors and heads of the divisions of the various cooperating agencies.

STUDIES OF HIGH PRIORITY TO BE UNDERTAKEN LATER

As the subprojects already outlined are completed, others will be outlined and work started. This project analysis and working plans should be revised and brought up-to-date about every three years. Some of the problems of high priority on which work is needed are as follows:

1. To study the kinds and extent of mineral deficiencies and the value of correcting them. Some exploratory studies are in progress at present, as mentioned in the section on mineral deficiencies and in subproject No. 4.

2. To study the poisonous plants, their distribution, abundance, effects on beef production, methods of control, poisonous properties, and the most practical solution to this problem.

3. To study proper breeding season and breeding age for cattle run on forest range.

4. To study the value of creep feeding calves on forest range at the Hofmann Forest. A similar study has been made at the Blackland Branch Station where the forage is more abundant and nutritious than that at the Hofmann Forest. Additional studies are needed, however, where the forage is not so abundant and nutritious to more nearly represent the entire Coastal Plain.

5. To study methods of wintering calves on forest range of the type prevailing at the Hofmann Forest. A similar study is in progress at the Blackland Branch Station where the forage is more abundant and nutritious than at the Hofmann Forest. Additional studies are needed, however, in poorer reed areas.

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6 October 1949

MEMORANDUM TO PROFESSOR HOSTETLER:

Reference is made to Mr. E. C. Elting's letter of September 23, 1949.

The "First Supplement to the Project Analysis and Working Plans for Studies in the Coastal Plain of North Carolina, Second Revision, March 1945" prepared in October 1947 gives the status of all work under these projects at that time. Since then subprojects 1, 2 and 4 have been completed and the data is in process of being analyzed.

Subproject No. 3, "Logging Effects and Degree of Grazing". The results of this subproject have been summarized and progress is being made for publication of these results.

Subprojects Nos. 7, 9 and 10. Field work has been completed on these subprojects. Chemical analysis of material gathered in these studies is being conducted by the Bureau of Animal Industry, Washington.

Subproject No. 6, "Wintering Calves on Reeds". This subproject has been temporarily discontinued pending development of Frying Pan Experimental Range in Tyrrell County. This project has not been known as "Subproject No. 2" insofar as I am able to determine.

Subproject No. 8, "Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina" is active at the present time with work being conducted at the Frying Pan Experimental Range in Tyrrell County. This project is also known as S46-ai17 and is one of the projects through which this station is contributing to the Regional Beef Cattle project.

In addition, Subprojects 11 and 12 are now active with work being conducted at the Tidewater Experiment Station, Plymouth, N. C., and at the Frying Pan Experimental Range.

We are enclosing a copy of the supplement to Project Analysis and Working Plans.

E. U. Dillard

E. U. Dillard

Enclosure-

Return to DWC

North Carolina State College of Agriculture and Engineering
of the
University of North Carolina
Raleigh

SCHOOL OF
AGRICULTURAL AND FORESTRY
RESEARCH EXTENSION
RESIDENT TEACHING

AGRICULTURAL EXPERIMENT STATION

OFFICE OF DEAN AND DIRECTOR

September 26, 1949

MEMORANDUM TO: D. W. Colvard:

I am enclosing a copy of a letter received from Mr. E. C. Elting of the Office of Experiment Stations regarding the status of work on the Purnell project "Utilization of Reeds in Forest Grazing." Will you please supply me with the information requested in this letter at your earliest convenience.

Sincerely yours,

R. W. Cummings
Associate Director

Enclosure

C
O
P
Y

Sept. 23, 1949

Dr. R. W. Cummings
Raleigh, N. C.

Dear Dr. Cummings:

#6 + #8

We would appreciate knowing what subprojects will be active this year under Purnell project 14,"Utilization of Reeds in Forest Grazing."

All are under Purnell 14

Are we correct in our understanding that the work formerly conducted under subproject 2, "Wintering Calves on Reed Pasture," is now being carried out under subproject 6? If not, we would like to have a plan of work for subproject 6 to bring our records up to date.

yes

Some samples sent to N.R. Ellis B.A.I. for analysis.

Likewise, if any research is to be done on subproject 7, "Relative Grazing Values and Nutritive Properties of Forage," and subproject 8, "Development of Beef Cattle, Especially Adapted to the Coastal Plain Region of North Carolina", a plan of work for each of them also, would be apprecated. —

Very truly yours,

Signed/ E. C. Elting
Associate Chief

file
Forest Grazing

SOUTHEASTERN FOREST EXPERIMENT STATION

R-SE-NACP
SUPERVISION
General

P. O. Box 479
Franklin, Virginia
March 31, 1948

Dr. J. H. Hilton
Dean of Agriculture
Patterson Hall
Campus

Dear Dr. Hilton:

Attached is the report of a committee appointed by Dr. L. D. Baver to study the future usefulness of the Hofmann Forest as a site for the conduct of the research under the Forest Grazing Project.

The committee finds that the Forest at present could be used with difficulty for some studies but is unsuited for others. Forage management investigations could be pursued on quadrats, by employing clipping and plucking in lieu of actual grazing. A restricted program of breeding could also be carried on using available pastures. And observations can be continued on the development of reeds in competition with brush, growth of seedling pond pines, and similar problems. But the management of herds involving 15 to 20 breeding cows, forage management studies employing actual grazing by cattle, and investigations of the effectiveness of grazing as a fire control measure cannot be studied on a scale commensurable with their importance.

The early completion of present plans for road construction on the Forest would increase somewhat its usability for research in forest grazing. But to make accessible areas suitable for herd management research would require

road construction beyond immediate plans.

Moreover, further research, particularly that involving the use of cattle, will require construction of new fences, scales, and feed houses.

Until the road system of the Forest approaches completion the fire hazard will remain a threat to the usefulness of areas otherwise suitable for research.

The committee, therefore, recommends that the State College and/the Agricultural Experiment Station seek an area suitable for studies of herd management, forage management by grazing, and the integration of range and timber management. Further, it urges that such an area be selected and obtained as soon as possible, preferably within the calendar year.

Very sincerely yours,

H. A. Stewart
C. M. Kaufman
Sheldon A. Shepherd
Earl A. Hostetler
Ivan H. Sims

REPORT ON THE ADVISABILITY OF CONTINUING THE USE OF HOFMANN FOREST FOR FOREST GRAZING RESEARCH

March 31, 1948

I. Introduction:

The Committee was asked to reexamine and evaluate the Hofmann Forest, in Jones and Onslow Counties, as to its suitability for continuing research under the Forest Grazing Project. Suitability has been considered as involving; first, the physical conditions on the ground (the extent and condition of forest and forage types, accessibility and road systems, fencing, etc.) and secondly, matters of program and policy for the development and management of the Forest.

This report is concerned chiefly with the physical conditions for they have been found to limit the kinds and scope of work that can be undertaken and preclude use of the Forest for others. Management policies and programs for the Forest will not seriously interfere with the types of research that can profitably be conducted on the Forest.

II. Historical Review of Forest Grazing at Hofmann Forest

Beef cattle work was begun in the spring of 1937 to determine if beef type cows could subsist and reproduce in the forest on the forage that was available. No specific agreement was entered into between the North Carolina Forestry Foundation and the Animal Industry Department but it was verbally agreed that the Foundation would erect fences, build roads and trails to the pastures and cut timber only as mutually agreed upon. The Animal Industry Department would own and supervise all cattle and annually pay to the Foundation one-half the value of all calves produced.

Because of the lack of adequate fencing the cattle were removed from the forest in the fall of 1937, but were returned later when federal funds became available for forest grazing.

The first study under the new program was begun in 1942. It concerned different planes of nutrition for wintering breeding cows on forest range. The use of different amounts of protein supplement (2, 4, and 6 pounds per head daily) was compared over a period of six years. The winter feeding periods extended from approximately January 1 to April 25. The evidence is not conclusive but points to the need for between 2 and 6 pounds of protein supplement daily, depending upon available forage and condition of the cattle. No significant differences in calf crop percentage or cow mortality were found between the several supplement rates employed. But calves were heavier at the beginning of the summer period in the group which had received 6 pounds of protein supplement; and cows on lower levels of supplement gained less during the winter but more during summer, so yearly gains were very nearly the same.

Studies were initiated in 1943 to study some of the mineral elements as they affected breeding cows and their offspring. At the present date no conclusive statements can be made though blood analyses have indicated possible deficiencies of copper, calcium and phosphorus.

There were no significant differences in cattle gains on logged and unlogged areas, but gains by both cows and calves were greater in the areas with the lighter rate of stocking (1 cow and calf for each 8-12 acres as compared to 1 cow and calf for each 5-8 acres). Logging was not completed in accordance with the plans and experimental design. Experimental

areas were highly variable at the close of the trials and the forage stand quite inferior to the stand at the start of the trial. The original experiment had to be abandoned in 1946. Since then the pastures have been usable only to hold the Brahman and Africander crossbred heifers developed in the following study.

Cows and heifers, mostly grade Herefords, not required in other experiments were divided into two groups in 1944 and 1945. One group was bred to a Brahman bull and the other to an Africander bull. In 1946 and 1947 a Brahman bull and Hereford bulls were used to breed extra cows. Through 1947, thirty-three first cross Brahman calves and 25 first cross Africander calves were raised to weaning age. At the present time no definite statements can be made as to the relative merits of these calves when compared to grade Hereford calves from similar cows.

Grazing habits of cattle were studied at the Hofmann Forest in an effort to determine the kinds and amounts of plants grazed at each stage of plant development. Cattle preferred a variety of forage, but reeds, bluestem grasses, and a small number of shrubs constituted the major portion of the diet in this area. Forage samples were analyzed chemically to determine if forage contained enough nutrients to meet beef cattle requirements. Protein was found to be deficient during the winter as were calcium and phosphorus. Even where forage is abundant a mineral mixture should be kept before the cattle and the use of protein supplement during the winter seems advisable.

In general it has been quite difficult to accurately evaluate the cattle work at the Hofmann Forest because of lack of adequate grazing in a given area. The fenced areas were too scattered and too inaccessible to enable the cattle to be handled economically and observed frequently enough for taking necessary records. It has been necessary, for example to choose between employment of two herdsmen (at Comfort and at Deppe) or to have one drive 70 miles each time he has work to do on one of the areas. One area (Kits Island) used as a holding pasture is accessible only on foot over an exceedingly rough trail. Several of the large pastures were incompletely fenced, which has increased the difficulty of collecting cattle.

Cattle losses have been excessive both from the standpoint of actual loss by death or otherwise and because of small calf crops.

Losses for the six year period, 1942-1947, are shown as follows:

Year	Cow Died	Cow Missing	Calves died	% Calf Crop Weaned
1942	3	0	0	54
1943	8	2	12	65
1944	5	0	0	51
1945	10	6	4	61
1946	13	13	3	43
1947	8	7	7	46
Total	47	28	26	53

The above table shows only cow and calf losses. In addition there were some losses among the two year old and yearling heifers that will be calculated later.

A tabulation of the cattle used in the various experiments, by years, is given below.

Number of cows and heifers used annually in forest grazing research on Hofmann Forest

Study	1942		1943		1944		1945		1946		1947	
	Cows	Calves	Cows	Calves	Cows	Calves	Cows	Calves	Cows	Calves	Cows	Calves
Different planes of nutrition for wintering breeding cows on forest range	54	-	96	-	91	-	85	-	97	-	70	-
Effect of intensity of cutting on forage production and cattle gains	-	-	60	60	60	45	40	40	40	40	-	-
Mineral requirement of cattle on forest range	-	-	40	-	30	-	28	28	26	26	20	20
Beef cattle especially Adapted to the Coastal plains of North Carolina	-	-	-	-	29	-	78	-	41	-	25	-
Total	54	-	196	60	210	45	231	68	204	66	115	20

III. The Research Program

The problems of forest grazing in North Carolina were analyzed in 1942 and a program of research for their solution was formulated, together with working plans for the studies to be undertaken immediately following. The program was amended slightly in 1945 and working plans for new studies were prepared. The problems involve three major fields: integration of grazing and timber management, cattle herd management, and forage management. What are considered to be the most important problems of each field are outlined below. These are the problems considered in evaluating Hofmann Forest as a site for continuation of the project. Although considerable progress has been made on restricted phases, particularly in the herd management field at Wenona, in general the major problems remain unsolved for the main grazing areas of the Coastal Plain.

A. Integration of grazing and timber management:

1. Fire control - determine the value of grazing for reducing fire hazards, and devise effective methods of applying it in a fire control program.
2. Pine regeneration - determine the value and most efficient methods of applying grazing, in conjunction with forest management, to encourage the establishment and growth of pine seedlings.
3. Hardwood control - investigate the feasibility of using cattle to control the invasions of undesirable hardwoods into pinelands.
4. Determine the value of forest grazing as a source of supplemental income in forest management.

B. Herd Management Problems:

1. Effect of degree of grazing and system of grazing on cattle performance.
2. Supplemental feeding - requirements and value for different classes of stock and at different seasons.
3. Coordination of the use of forest range with that of improved pastures.
4. Mineral supplement requirements of animals while on forest ranges.
5. Optimum breeding age and calving dates for range conditions.
6. Importance of poisonous plants as a hazard in forest grazing.
7. Breeds of cattle best adapted to forest range conditions.

C. Forage Management Problems:

1. Develop reliable criteria for judging grazing capacity.
2. Devise improved systems of management such as deferred and rotation grazing.
3. Determine how to control brush on forest range - which may involve the use of fire as a management tool.

IV. Conditions required for the research

To be suitable for research in range and forest management an area must have certain general characteristics. Among the more important of these are accessibility, safety, uniformity, extensiveness, and representativeness of the vegetation types to be studied. Pastures, paddocks, and plots must be accessible by truck or car at all seasons to permit feeding and handling of the cattle, making

observations, applying treatments, and for demonstration purposes. Safety from accidental wild fire is, of course, a prime necessity, not alone from the viewpoint of possible loss of livestock but also because of the cumulative investment in research effort. Uniformity of cover over relatively extensive areas is required to permit replication of a series of treatments, each of which by itself takes considerable area. Future applicability of the research results demands that the areas used bear forage and timber types representative of an important part of the Coastal Plain.

In addition to these general qualifications, an area, to be suitable for research on the integration of timber and range management should have grazable forage associated with mature timber ready for harvest and regeneration, or immature forest in need of cultural treatments. Full control of cutting by the research agencies is well-nigh imperative to assure compliance with the experimental designs.

Herd management studies need sufficient range to support eight to twelve herds of about fifteen head each. That would mean some 3000 to 4000 acres of the kind of reed range found on Hofmann Forest. As a matter of economy it should be possible to install pastures contiguous thus saving on feed, watering, and weighing facilities.

Forage management studies, other than those employing plucking or clipping quadrats, have, perhaps, the highest requirement as to extensive and uniform areas. Each pasture must be large enough to support three or four head of cattle for a season. When multiplied by replication of several levels of use the requirements for a single experiment may amount to several hundred acres of very uniform forage. At Hofmann Forest the required area is estimated to be 320 to 720 acres for each

study. The accessibility requirement is also high for forage management studies, for their very nature requires frequent seasonal observations, measurements, and collections.

V. Forage and accessibility conditions on Hofmann Forest:

Forage Survey

The survey of the forage areas on Hofmann Forest was started by outlining all probable areas on the aerial photographs of 1938. The outlined areas were then located on a map of the Forest drawn to a scale of 2 inches per mile. Grass and savannah areas were identified as distinct from switch cane whenever possible.

During February, 1948, field checks of the more promising areas were made by I. H. Sims and W. O. Shepherd of the U. S. Forest Service and C. K. Kaufman of the N. C. Agricultural Experiment Station. These field examinations made possible identification of the existing situation with the situation as represented on the aerial photos, particularly the presence or absence of forage on areas identified as forage areas on photos, and a more accurate location of forage type boundaries. Data on the density and quality of the forage was also obtained. Ground surveys were made in the Horsepen Ridge area, the East Quaker Bridge Road area, and the Savannah in Pastures A and D, at Deppe (areas I, IV, X respectively on the map).

Following the ground examination, W. O. Shepherd made a flight over Hofmann Forest. During the course of the flight he identified the forage types on questionable areas and made additional corrections in forage type boundaries.

After the field work was completed a final revision of areas of forage was made on the map by re-examination of the aerial photographs. The acreage of the various areas was then determined by planimeter. The result of the survey is shown in the following table.

Location, acreage, type, and quality of forage on forage areas in Hofmann Forest.

Map No.	Name	Type and Quality of Forage	Gross Acreage
I	Horsepen Ridge	Cane. Low to good capacity	541
II	Black Sand Ridge	Cane. Fair	1,981
III	Logged Pasture	Cane. Fair (pastures 400A. other 268A.)	668
IV	East Quaker Bridge Road	Cane. Fair	661
IVa	Neighboring bed (1/2 mile west		115
V	Davis Field	Cane.	982
VI	Kits Island	Cane. Fair to good	1,042
VII	Deppe Trail	Cane. Fair to good	562
VIII	Reese Trail (2 beds)	Cane. Poor to fair	579
IX	Pasture A, B, & D	Savannah. Poor to fair Additional fringes of cane	1,564
X	Pasture C	Wiregrass Savannah. Poor to fair Additional fringes of cane	200 ? 700

Quality of forage

On Hofmann Forest cane brakes are intermixed to varying degrees with unpalatable brush. The two areas examined, No. 1 and No. IV, were burned in 1945. Fire tends to improve the position of switch cane relative to brush; hence, these two areas probably are less brushy than the cane brakes in portions of the Forest where burns have been less recent. But, even in these areas the patches of pure cane are small and not common.

Density and height of the switch cane also vary greatly. In the major cane areas as shown on the map the height is from 2-1/2 to 4 feet and the average carrying capacity for year-long grazing approximately 2 acres per animal month.

The savannahs are predominately of a wiregrass type. No recent extensive burns have occurred in Block 10 in which the A, B, C, and D pastures are located. The result has been that sprout and seedling growth of pond pine has reforested the savannah area to a considerable degree. Their grazing value has been proportionately reduced.

Accessibility

None of the forage areas shown on the map are now accessible by all-weather roads. The roads into areas III and IV would need to be graded, including raising by several feet in some places, before year long use would be possible. In the case of area IV about 2 miles would need to be rebuilt. Area I is now accessible by a former logging road but the entire distance of about 2-1/2 miles would need to be rebuilt plus the construction of several more miles to make the entire area usable as a grazing area. The largest and most promising bed of switch cane is area II but some 5 to 8 miles of all-weather road must be constructed before it will be usable for research purposes. Areas VI and VII are accessible only by tractor or afoot. Area VI would require about 4 miles of road.

Under the development program for the immediate future area VII would be the first to become fully accessible. In the program a road will be built along the Deppe Trail followed by rebuilding

of the Roper Road. The plans call for a ditch adequate for draining off the surface water, with an all-weather road on the spoil bank. Following the Deppe Trail-Roper Road work, a road of similar type will be built on the Block line intersecting area I to the common corner of Blocks 1, 2, 3, and 4. Next, the Quaker Ridge road will be rebuilt and a road will be built on the Cypress Creek Trail from the barn at Comfort. A road will be built from the Quaker Bridge to the Roper Road. The complete development program calls for a raised all-weather road on all the block lines and secondary roads on the section lines.

Dragline operations have been started on the Deppe Trail at the Forest headquarters. Construction of this type will proceed slowly. No positive statement can be made regarding the time when any portion or all of the development program will be completed.

VII. Conclusions.

1. Hofmann Forest, at present and in the foreseeable future is unsuited for important parts of the Forest Grazing research program: Specifically, because forage areas, otherwise usable, are inaccessible, variable, undeveloped, and lack reasonable protection against wild fire.

2. Hofmann Forest can be continued as the site for quadrat studies of forage management.

3. There is reason to question whether the brushy switch cane types on Hofmann Forest are representative enough switch cane in the Coastal Plain to justify it as a site for the forest grazing research program.

VIII. Recommendations

It is recommended that steps be taken immediately to obtain an area fitted to the needs of the Forest Grazing research program; and that for the ensuing grazing season the forage management quadrat studies and the testing of crossbred cattle be continued at Hofmann Forest. Every effort should be made, however, to have the new area selected and initial development work such as fences, water, and weighing facilities installed by about January 1, 1949.

The University of North Carolina
Institute of Statistics
Raleigh

GERTRUDE M. COX, DIRECTOR
WILLIAM G. COCHRAN, ASSOCIATE DIRECTOR
HAROLD HOTELLING, ASSOCIATE DIRECTOR

March 18, 1948

Memorandum To: R. W. Cummings

From: H. L. Lucas

I have studied over the project outline on the "Role of Forest Grazing in Beef Cattle Production in Southeastern United States." Projects 9, 10, 11 and 12 are very well written. I have penciled in a few wording changes in the manuscript, and think that perhaps a sentence or two might be added on page 11 in sub-project 10. These sentences should be to the effect that the design, due to a lack of replication, allows no estimate of the error for general application of the results. The design gives only an estimate of error pertinent to the particular site involved in the study. I am sure the author is aware of this point and plans to do more extensive studies after basic techniques have been worked out. On page 12, near the bottom, a phrase is included to the effect that the error term is of questionable reliability. This phrase should be stricken out because the sentences just suggested explain what the author means by the term, questionable reliability.

Sub-project 13 was not written very well. I have penciled in changes in sentence structure and wording in the manuscript (pages 33, 34, 35). There are also some comments to be made on the design of the experiment. One of these is relative to item 3 on page 34. The process of alternating the groups between ranges at 2-week intervals tends to under-estimate the amount of feed required for the "maintenance" treatment and to over-estimate the feed required for the "gain" treatment. How serious such errors are probably depends to a large extent on how heavily the pastures are grazed. The procedure of alternating is apparently incorporated in order to cancel pasture differences and thereby reduce experimental error. This may or may not be a desirable thing to do depending on the aims of the study. I would judge it would be much better to not use the alternating scheme, but rather set up the experiment on a replicated basis, that is, with two or more pastures on each feeding treatment. Some objective characterization of the carrying capacity of the pastures should also be made. These changes seem necessary if the results are to be of any practical value. I say this because there is little doubt in my mind that the amount of supplemental feed required to maintain weight or to provide the desired rate of gain will vary tremendously from pasture to pasture and from location to location.

The analysis proposed by the author is

Source of variation	d.f.
Between groups	1
Heifers in groups	N-2
Total	N-1

This analysis has absolutely no meaning for the winter feeding results because the author is feeding the animals to maintain some arbitrary average rates of growth which are known to be different for each group. The variable truly under study thus is the feed required to obtain the desired average rates of growth and not the rates of growth perse. Obviously there will be only two data for the experiment, one for each group. Thus, no analysis is possible. On the other hand, the analysis proposed can be properly used for a study of subsequent growth and reproduction. In this event covariance on winter gain would improve the analysis considerably.

To sum up the comments just made relative to sub-project 13, it can be said that the experiment is very poor from the standpoint of estimating the feed required to give a desired winter gain, (this criticism can only be over-come by replicating the experiment, either at the one site or preferably at several other sites in the region). On the other hand, the effect of rate of winter gain on subsequent growth and reproduction can be assessed quite well from the experiment.

Knowing something about the conditions under which sub-project 13 must be conducted, I think little can be done with regard to improving its bad features. I think, however, the author should point out the deficiencies and make strong the point that the experiment will be replicated when facilities are available.

H. L. Lucas
Associate Professor

HLL:r

THE ROLE OF FOREST GRAZING IN BEEF CATTLE PRODUCTION IN SOUTHEASTERN UNITED STATES

WORKING PLANS FOR NEW STUDIES DURING 1948 IN THE COASTAL PLAIN OF NORTH CAROLINA

(This is a supplement to the revised Working Plans of March 1945.)

Seven major problems of forest range grazing are listed in the approved problem analysis and working plans of June 1942, and the revision of March 1945 (page 10). Since the research program could not cover all of these at one time, the aim in the early stages of the project has been to "first tackle those phases which it is thought will yield the greatest and quickest returns to the farmer". The studies thus far have dealt largely with the cattle management phases of "finding the most practical systems for utilizing the reed (switch cane) forage type by beef cattle". Although certain phases of this problem will be continued, studies have progressed to the stage where considerable effort can be shifted to other important problems. The study plans included in this supplement involve two major problems included in the original problem analysis which are now considered to be of primary importance, fire protection and forage management.

PRESENT STATUS OF STUDIES OUTLINED IN THE REVISED WORKING PLANS OF MARCH 1945

The grazing program which has been carried on in the vicinity of the old Blackland Branch Station at Wenona will be transferred to the Tidewater Experiment Station, near Plymouth. The desirability of such a move became apparent (and was anticipated in the 1945 working plans) when the Blackland Station was sold and replaced by the Tidewater Station in 1944. The studies now in progress will be closed out according to schedule at the end of the 1947 grazing season.

At Hofmann Forest the need for additional research facilities and a revision of the studies has become increasingly evident in recent years. Inadequate roads, trails and fences has made cattle management difficult and has resulted in exorbitant losses of experimental cattle. A lack of suitable winter pastures tends to limit the application of results of wintering studies. An initial lack of uniformity among the "logged pastures", in both forage stand and logging treatment, has been aggravated by repeated wild fires and overgrazing to the extent that these pastures are of limited value to the study for which they were designed. However, observations in these pastures have emphasized the importance of fire as a problem and also as a valuable tool in grazing and timber management. To attack some of the most important forest grazing problems on a sound basis at Hofmann Forest will require a new set of experimental pastures. Whether it will be most feasible to locate these pastures at Hofmann Forest or at some accessible area, is now under consideration. When a decision is reached the project analysis and working plans will be revised to incorporate results obtained to date and new studies to be undertaken.

The subprojects outlined in the 1945 study plans are listed below and the present status of each is indicated. All studies which are being completed or

closed out will be analyzed as soon as possible and reports prepared for publication.

Subproject No. 1, "Effects of Heavy Grazing and Moderate Grazing on Reeds and on Cattle Gains at Wenona". This study culminates at the close of the 1947 grazing season in November.

Subproject No. 2, "Use of Reeds in Finishing Yearling Steers". This study, conducted at Wenona and Tidewater Station, will be completed at the close of the third finishing trial in the spring of 1948.

Subproject No. 3, "Logging Effects and Degree of Grazing". This study at Hofmann Forest, scheduled to run "at least 10 years", was closed out in 1946 after four grazing seasons when it became apparent that little additional information would be obtained by continuing it further. The pastures lacked uniformity both as to forage and logging intensity, and the data are not conclusive regarding the effects of logging or degree of grazing on cattle gains. Two wild fires in 1945 further accentuated differences among pastures and disrupted the original design. These pastures now are useful only for studies requiring no pasture comparisons.

The study has shown that grazing has significantly increased the establishment, mortality and growth of pine seedlings. Some pertinent information has also been obtained regarding the effect of fire on pond pine regeneration. A report on these phases is being prepared for publication.

Subproject No. 4, "Mineral Requirements on Forest Range". This study, which has been conducted at Hofmann Forest under the supervision of the Animal Nutrition Section, Department of Animal Industry, N. C. State College, is being closed out with the calving data to be obtained in the spring of 1948. The study failed to demonstrate a cobalt deficiency in the forage, perhaps due to the fact that all cattle received supplements of bonemeal and cottonseed meal which contained traces of cobalt. The study was redesigned in the fall of 1946 but it is being discontinued until better facilities for a well controlled experiment are available.

Subproject No. 5, "Different Planes of Nutrition for Wintering Breeding Cows on Forest Range". The sixth trial comparing three levels of protein supplements (two, four and six pounds per head daily) from January until April, was completed in 1947, when this study was closed out. Results of the first two trials, and an earlier one comparing two and four pounds of supplement, were published in 1945. The range pastures on which these trials were conducted were quite heterogeneous and somewhat deficient in desirable winter forage. Further wintering studies are needed with variations of the supplemental feeding program and on ranges more suitable for winter use.

Subproject No. 6, "Wintering Calves on Reeds". This was set up as a three year study at Wenona. Fires in 1941 and 1943 interrupted the experiment, but two trials were conducted during the winters of 1942-43 and 1944-45. This study will be continued at Tidewater Station, or elsewhere, when facilities are available.

Subproject No. 7, "Relative Grazing Values and Nutritive Properties of Forage". The forage sampling and chemical analyses for this study have been completed. The data are being summarized by N. R. Ellis, of the Bureau of Animal Industry, U. S. Dept. of Agriculture. Observational data concerning palatability, season of use, relative importance, etc., have been collected in all of the grazing studies and will be continued in future studies.

Subproject No. 8, "Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina". This long-term project, begun in 1944, is being continued. In 1947 two-year-old heifers obtained by crossing grade Hereford cows with Brahman and Africander bulls were bred to young bulls of the same ancestry for the first time in this study.

Effect of Degree and Season of Defoliation on the Productivity and Vigor of Switch Cane.

(Subproject No. 9)

Purpose:

An exploratory investigation of the response of switch cane to definite degrees of defoliation at different seasons. The results obtained here will be of greatest value as background information for developing improved management methods and grazing studies involving switch cane.

Importance of Study:

The ambiguous terms, "heavy", "moderate", and "light" have commonly been employed to indicate intensity of utilization. To be meaningful, these terms must be defined according to some tangible criteria such as per cent defoliation or utilization at particular seasons. The degree of defoliation that switch cane will endure at various seasons, and still maintain its vigor and productivity, has not been determined. Such information is needed for intelligent management of this most important native forage species of North Carolina's Coastal Plain region.

Switch cane forage fits well in a grazing program during one or more of the following periods:

(1) During the spring and early summer before lespedeza and other late pastures are producing well.

(2) During the entire summer to supplement, or replace, farm pastures.

(3) During the fall or winter after permanent pastures have become dormant.

These periods are included in the present investigations of arbitrary "light" and "heavy" rates of utilization, and also "total" defoliation, employing hand harvesting.

Status:

The study was begun informally in 1946 and is now in the second season. Observations thus far indicate: (a) that the bulk of the annual forage growth on ungrazed cane occurs in May and June; (b) regrowth of foliage is slight and new leaves are small following defoliation in July or later, and does not begin for at least one month after defoliation; (c) growth is apparently dormant by November; (d) light utilization, as practiced here, stimulates very little regrowth; (e) more than one year is necessary to evaluate the effects of the treatments being used, since the early foliage growth appeared to be normal on all plots the second season.

Methods and Procedure:

Hand plucking on small plots is employed to simulate grazing effects of the following seasons and intensities of utilization:

Continuous early (May through July), both light and heavy.

Continuous summerlong (May through November), light and heavy

Winter (Nov. - Dec.), light and heavy.

Total utilization (one time per annum) in May, July, and Sept.

(In addition to these nine conditions, check plots with no utilization are included for comparison.)

The degree of defoliation arbitrarily selected for "heavy" utilization is 40 percent of the available foliage each month for both the "early" and "summerlong" periods, and a single 100 percent defoliation in winter. The corresponding "light" utilization rate is 15 percent each month for summerlong", 20 percent for "early", and 50 percent in winter. A constant percentage was adopted as the basis of degree of utilization because no reliable information was available to indicate the amount of initial growth to expect, and considerable regrowth was anticipated. A single defoliation in early winter is expected to provide an adequate, though rigorous, test of winter utilization

because growth is dormant at that time and some of the older leaves are shedding.

Location:

The study is being conducted in a uniform stand of ungrazed switch cane just west of the "logged pastures" at Hofmann Forest. The area had been completely burned over by a severe wild fire of early April 1945. New growth of the cane was vigorous and uniform, over-topping all brush sprouts.

Number and size of plots:

Plots representing each of the nine utilization treatments, and also an untreated check plot, are replicated three times, making a total of 30 plots. Each replication is grouped in a block of plots separated from the other blocks by a distance of 70 to 80 yards. Each plot is 3.3 x 6.6 feet (1/2000 - acre).

Establishment of plots:

In each block area 10 plots were selected for uniformity; then treatments were assigned at random. The plot corners were marked by wood stakes about two feet long, and wire was strung between the stakes to clearly delineate the boundaries.

Brush sprouts were cut off near the ground and removed from the plots. This procedure will be repeated at least once each year in order to minimize possible effects of brush competition.

Harvesting procedure:

The specified percentage of foliage is plucked by hand from each individual cane stalk. So far as possible, the cluster of three to six leaves of an individual branch are plucked together, that is, utilization is by branch clusters. To obtain greatest accuracy, individual leaves were the unit of utilization at the beginning of the study. It became apparent that plucking one or two leaves from a cluster did not simulate grazing conditions as closely as did plucking a cluster at a time. Therefore the procedure was changed the second season.

Harvested forage is bagged separately for each plot and both green and oven-dry weights are obtained. Any rhizomes connecting plants inside the plots with plants outside, are cut each spring by spading and/or chopping to a depth of 10 inches along a line completely surrounding the plots and one foot outside the boundary. This one-foot "buffer" strip receives the same treatment as the plot. (During the first season, while the advisability of severing connective rhizomes in this manner was being investigated, a three-foot buffer strip around each plot was included in the utilization treatments and rhizomes were not cut.)

Harvesting begins when the cane has put out two full leaves (usually early in May) and continues at four-week intervals thereafter until the winter harvesting in November or December.

Records:

In addition to forage yields, the following information is recorded each time a plot is harvested:

Q Estimated foliage density (in percent of ground cover)

cane height Average number and size of leaves per stalk (estimated from sample counts and measurements)

Average number of leaves harvested per stalk (estimated)

Observations on amount of regrowth, condition of forage, etc.

The approximate number and size of live stalks, dead stalks, and new basal shoots will be recorded at the end of each season. Average cane height and estimated foliage density were recorded for all plots at the beginning of the study.

Duration:

The study should be continued at least through the third season (1948).

Statistical analysis:

For forage yields, and other comparisons of the nine utilization treatments, the following analysis will apply (for one year):

Source	d.f.
Blocks	2
Treatments	8
Error	16
Total	26

For comparisons including the check plots, the degrees of freedom would be increased to 9 for treatments and to 18 for error.

To increase precision, the forage yields may be adjusted for initial plot density, cane height, or number of stalks per plot by covariance analysis.

Supplemental Information:

For additional evaluation of the cumulative, or residual, effects of these treatments it may be feasible to determine the levels of food reserves of the cane at the close of the study (see subproject 10), or to harvest the total forage produced the following season.

Organic Food Reserves of Switch Cane in Relation to Season and Stage of Growth

(Subproject Number 10)

Purpose:

To determine the seasonal fluctuations of the food reserves of switch cane, in relation to recognizable growth stages, as a basis for better understanding the proper management of this forage species.

Importance and scope of study:

The depletion of stored foods during the early rapid growth stage, and the replenishment of food reserves during subsequent stages of growth, are well known phenomena of seasonal development in perennial plants. Various studies with perennial forage species have shown that harvesting the foliage when the food reserves are at a low level tends to reduce the vigor and productivity of the forage stands. For sustained forage production, the plants must be allowed to build up their food reserves between harvestings.

Switch cane appears to possess the facilities for rather remarkable food storage capacity in its stout rhizomes and perennial stems, but this species is very sensitive to misuse and is easily weakened or killed by heavy continuous grazing. Simple microchemical tests show that the rhizomes contain abundant starch and recognizable amounts of sugar. Undoubtedly the accumulations of these and other plant foods fluctuate considerably during the year, and probably in relation to recognizable stages of seasonal growth. If the periods of depletion and low levels of food reserves, and also the periods of replenishment and high reserves, could be established, it would contribute materially to a better understanding of proper management of the switch cane forage type. Such is the primary objective of the present study.

Information will also be obtained pertaining to the principal storage products, the relative importance of aerial stems as storage organs, the gross

chemical composition of the leaves and other plant parts at different seasons, and relationships among several chemical components. Such information will provide a basis for simplifying further studies involving food reserves, and will also add something to the present meager knowledge of switch cane physiology.

This physiological approach may prove to have rather wide application in switch cane management research. Since a depletion of the cane's food reserves probably precedes the apparent reduction in vigor and forage productivity resulting from misuse, it seems quite logical to expect that a measurement of the food reserves might be helpful for an early evaluation of management studies and for detecting deterioration of cane vigor before the forage stand is seriously damaged. This application will be tested in the future if the results of the present study indicate that it would be feasible.

Status:

This investigation was begun informally in 1946. Samples of stems and rhizomes have been collected at monthly intervals since July 1946 except for the months of January, February and March in 1947. Preliminary chemical analyses have been made and the preservation methods and analytical procedures to be followed have been adopted. It has been found that oven-drying (at 70°C) and alcohol preservation of the plant material give comparable results, and that the dried samples are more easily processed in the laboratory.

Methods and Procedure:

Plant material:

Rhizomes and stems are collected at monthly intervals throughout the year. Leaves are also sampled except in late winter when insignificant amounts remain on the plants in the open site where the collections are being made.

Sampling area:

In order to minimize possible effects of site variation, all samples are collected in a restricted area at Hofmann Forest, and from cane of uniform height. This particular area was burned in 1945 and now has a uniform stand of cane $3\frac{1}{2}$ to $4\frac{1}{2}$ feet tall, a limited amount of brush, and very few trees.

Collection and preparation of samples:

Pieces of sod of convenient size (one to two square feet) are cut out, with the aerial portions intact, and washed free of soil. Roots are removed and surface water allowed to evaporate from the rhizomes. Then, approximately 200 gram samples (green weight) of the leaves, stems, and rhizomes (including the underground portions of the stems) are collected in paper bags, the stems and rhizomes being cut into segments less than an inch long to facilitate drying. Each sample is a composite of several groups of plants. Whenever possible, sampling is done about the same time of day (early afternoon) every month.

As soon as they can be transported to Raleigh the samples are dried to constant weight in a forced-draft oven at 65° to 70°C. They are then shipped to the chemical laboratory for analysis.

During 1946 the freshly cut material was placed in glass jars and sufficient 95 percent alcohol was added in the field to provide at least an 80 percent solution after dilution by the water in the plant tissue. The drying method was substituted in 1947 after tests showed that the two methods gave comparable results.

Chemical analysis:

The samples are being analyzed at Beltsville, Maryland and Tifton, Georgia under the direction of N. R. Ellis, Principal Chemist in Charge, Animal Nutrition Investigations, Bureau of Animal Industry, U.S.D.A. Determinations are being made for total sugars, starch, ether extract, crude protein, cellulose, lignin, crude fiber and ash. After relationships among these constituents are established for switch cane, several of the determinations can probably be omitted with impunity in further studies.

Records:

The samples are weighed when they are bagged and again when removed from the drying oven.

On each sample date, the following items are noted and recorded:

Stage of growth and condition of foliage

Time (hour) of sampling and drying

Soil moisture conditions and height of water table.

Any unusual observations or circumstances.

Duration:

The study will be carried through two full years at which time it will be decided from an inspection of the data whether or not more samples are necessary.

Statistical Analysis:

Considering the type of data involved and the experimental design used, it is believed that a statistical treatment would be of limited value in the interpretation of this study. However, the following analysis might be applied to test variation between months and between years, for any one of the chemical constituents, ~~although the reliability of the error term may be of questionable reliability.~~

Source	df.
Months	11
Years	1
Months x years (error)	11
Total	23

Forage Species and Construction Methods Useful for Establishing Pasture Firebreaks in the Pond Pine Forest Type.

(Subproject Number 11)

Purpose:

This is an exploratory study to investigate (a) techniques for the construction and establishment of pasture firebreaks and (b) forage species adapted to Coastal Plain forest sites and suitable for use on firebreaks.

Importance and scope of study:

Wild fire is the major hazard of the forest industry in much of the Coastal Plain of North Carolina. At the time of the 1937 forest survey, almost 100 percent of the pond pine-hardwood type showed evidence of burning, and on 1/4 to 1/3 of its area fire had been severe enough to kill saw-timber trees (Forest Survey Release No. 4 and No. 5, 1940). Although the damage was less severe in other types, from 71 percent (in the northern division) to 82 percent (southern division) of all forest land in the Coastal Plain gave evidence of having been burned over. In this area fire conditions have improved but little in recent years and many areas continue to burn over every two to five years. Fire control is difficult because of the expanse and limited accessibility of forest tracts with few fire barriers. The prolific understory of herbs and brush which characterizes the Coastal Plain forests produces intense fires which are difficult and dangerous to combat. Wet conditions which ordinarily prevail over much of the year add to the difficulty and expense of maintaining an adequate system of firebreaks in preparation for the occasional dry periods of high fire hazard.

There are good indications that grazing might be applied to the fire problem to good advantage. Definite benefits of grazing were demonstrated on three recent occasions at Hofmann Forest when wild fires died out or were brought under control upon entering the experimental range pastures. Observations at

the Wenona experimental area and elsewhere indicate that fire hazards are materially reduced by grazing. If it were applied specifically for maximum fire protection, the efficiency of grazing as a fire control tool could undoubtedly be greatly increased. One of the most promising applications appears to be in the cheap maintenance of wide fire lanes or "pasture firebreaks", established at strategic locations so as to prevent fire from entering the forest or to break up large tracts and thus confine accidental burns to relatively small areas. This method involves the establishment of a "sod" of pasture plants which will prevent the invasion of inflammable native vegetation onto the lane, and which in itself will be a fire barrier by virtue of being green or closely grazed during the fire season. By themselves, such lanes could not be expected to stop intense fires in a strong wind, but under the dry conditions of bad fire seasons they would serve as emergency access roads and provide relatively safe avenues of attack for fire fighters and equipment.

As a prerequisite to investigating this means of fire control, information is needed on practical procedures for constructing the fire lanes and preparing the seed bed, and on forage species which are suitable for this purpose and adapted to conditions encountered in forests of the lower Coastal Plain. It is with these preliminary phases that the present study is primarily concerned. If results and observations here indicate that this application of grazing is practicable, the method will be developed further in later studies.

Status:

This is a new subproject.

Methods and Procedure:

Phase I. Methods of constructing fire lanes and preparing for seeding. The following implements and methods will be investigated:

A. Brush cutter only -- no ditches at sides of fire lane.

B. Brush cutter as in A but ditched at both edges by use of a fire plow or angle-dozer.

C. Fire plow for working up fire lane and angle-dozer or road grader for leveling, with ditches left at both edges.

A bush-and-bog harrow, or other farm implement, will be used to supplement these methods if necessary to prepare a suitable seed bed.

Number and width of lanes: (All lanes will be 1/4 mile long.)

Three lanes 1 rod wide; each constructed by a different method.

One lane 2 rods wide constructed by method B.

Location of lanes:

The lanes will be oriented north-south in Block I of the Tidewater Experiment Station. They will be spaced at least 200 feet apart. After the sites for the lanes have been selected, the location of the specified types of lanes will will be randomly assigned.

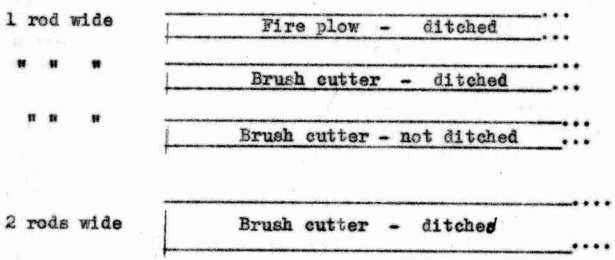
Site preparation:

Old trees and reproduction too large to be cut up by the brush cutter or fire plow will be removed in advance by the most feasible method at hand.

Records (Phase I):

Records will be kept of the cost of establishing a suitable seedbed on each lane; equipment and man hours required for each phase of construction, the number of trips over the same area required for each type of equipment, etc. Also observations concerning the apparent adaptability of each kind of equipment for the site conditions encountered will be recorded.

Diagram of lanes



All lanes approximately 75 rods long.

Phase II. Forage establishment.

Promising forage species and mixture will be tested on the fire lanes constructed in Phase I. The principal criteria in judging a species or mixture will be its utility in the maintenance of an effective firebreak under forest grazing conditions. Good forage productivity, particularly from early fall until late spring, is also desirable.

Species and mixtures:

The following species will be tested in pure stands and in all possible simple mixtures combining one grass with one legume:

Grasses

Italian ryegrass (Lolium multiflorum)
Tall meadow fescue (Festuca elatior arundinacea), Ky. 31 or Alta strains.
Redtop (Agrostis alba)
Dallisgrass (Paspalum dilatatum)

Legumes

Subclover (Trifolium subterraneum), Mt. Barker or Tallarook strains
Ladino clover (Trifolium repens)
Wetland deervetch ("big trefoil") (Lotus uliginosus)
Kobe lespedeza (Lespedeza striata)

These species represent winter annuals and cool weather perennials of both grasses and legumes, a summer perennial grass, and a summer annual legume. Also, grasses and legumes having rather low fertility requirements and tolerant of wet conditions are included. They were selected by the Department of Agronomy, N. C. State College as representing the kinds of forage species offering most promise for firebreak pasture mixtures in the Tidewater section of the N. C. Coastal Plain. No information is now available concerning their value for this particular use.

Rate of seeding and time of planting:

The following rates of seeding are expected to give satisfactory forage stands:

Species	Lbs. of seed per acre	
	In pure stands	In mixtures
Italian ryegrass	50	35
Tall meadow fescue	20	12
Redtop	15	10
Dallisgrass	25	15
Subclover	20	15
Ladino clover	4	3
Wetland deervetch	6	4
Kobe lespedeza	40	20

All plots will be sown as early in the spring as moisture conditions permit. Since ryegrass and subclover are not well adapted to spring sowing, these species will be resown in the fall if they fail to make a stand and produce a seed crop the first season.

Soil treatments:

All lanes will be limed uniformly at the rate of 3 tons per acre. The lime will be applied during the last phase of seedbed preparation.

All legume and mixture plots will be fertilized with 2-12-12 fertilizer, at the rate of 500 pounds per acre, prior to seeding. Grass plots will receive 600 pounds per acre of 10-6-4 fertilizer, This will provide 60 pounds per acre of P_2O_5 and K_2O for plots containing legumes, and 60 pounds of nitrogen per acre for plots with grass only.

These rates of liming and fertilizing have been suggested by the Department of Agronomy as about the minimum which will probably be satisfactory for obtaining a good stand of all the species being tried. Although there is a need for information concerning the response of those species to different levels of lime and fertilizer, particularly under the conditions being investigated here, this phase has been omitted to simplify the experimental design.

Number and size of plots, and experimental design:

Plots will be the width of the lanes and 24 feet long, allowing 50 plots per lane.

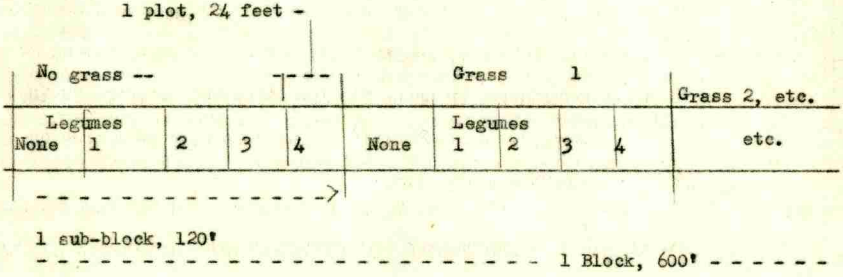
There will be two blocks (replications) per lane, with 25 plots per block.

Blocks will be divided into sub-blocks of 5 plots; 4 plots seeded to one each of the legumes and the other with no legume.

Each of the four grasses will be seeded over an entire sub-block; the other sub-block will have no grass (only legumes and a check plot not seeded).

Species will be assigned to plots and sub-blocks at random.

Diagram of planting design for each lane



Management of fire lanes:

The lanes will be open to grazing at all times except for the first month or two of the initial growing season. Brush or other invading species will be removed the second or third year if necessary to maintain the usefulness of the lane as a firebreak. For this purpose a brush cutter, bush-and-bog harrow, or other suitable equipment will be used.

If additional fertilization appears to be needed during the second or third season, the design can readily be modified to incorporate this treatment on half plots.

Records:

Forage stand will be estimated in early summer and early winter and rated 1 to 10, 1 being excellent.

Density of ground cover will be estimated (in tenths) for forage species and weeds in late fall or early winter.

Apparent inflammability of ground cover will be rated during the usual fire season of late winter and early spring; rate 1 to 10, 1 being minimum inflammability (excellent protection). It may be feasible to augment this rating by firing one edge of each lane with a torch during dry weather and recording the distance and rate of fire penetration into each plot.

Observations of relative palatability, seasonal growth, and general performance of individual species and mixtures will be made and recorded periodically.

Forage yield will not be attempted the first year. This measurement will be included later if it seems to be desirable and if facilities and available labor permit.

Statistical analysis:

The following analysis will be applied to forage stand and inflammability data (analysis shown for one year):

Source	d.f.	
Lanes (L)	3	
Blocks (B)	1	
B x L (error a)	3	(applies to B)
Grasses (G)	4	
G x L	12	
G x B	4	
Gx B x L (error b)	12	(applies to G, G x L, & G x B)
Legumes (Lg)	4	
Lg x L	12	
Lg x B	4	
Lg x B x L (error c)	12	(applies to Lg, Lg x L, & Lg x B)
Lg x G	16	
Lg x G x L	48	
Lg x G x B	16	
Lg x G x B x L (error d)	48	(applies to Lg x G, Lg x G x L, Lg x G x B, G x B x L, and Lg x B x L.
Total	199	

This analysis can be refined further to test the performance of individual species or mixtures.

Note: There is no error term for testing the significance of differences between lanes. If appreciable differences occur, field observations will probably account for them. A future replication of this study, here or elsewhere, will provide an estimate of error for testing lane differences.

Dr. H. L. Lucas of the Institute of Statistics, N. C. State College, has approved the design of study and has suggested the analysis presented here.

Materials needed:

Machinery and equipment:

A heavy fire plow, an "angle-dozer" or heavy road grader, a rotary brush cutter and possibly a bush-and-bog harrow, and a truck-type tractor.

Land area to be seeded:

Three lanes 1 rod wide, and one 2 rods wide, at least 75 rods long; approximately 1/2 acre in each narrow lane and one acre in the wide lane, a total of about 2½ acres.

Lime and fertilizer:

Lime - 7½ tons

2-12-12 fertilizer - 1050 pounds

10-6-4 fertilizer - 260 pounds

Seed:

Sufficient seed of each species to plant ~~.43~~ .1 acre in pure stands and ~~1.66~~ .4 acres in mixtures at the rates specified.

Duration:

At least three years.

Grazing Capacity of Switch Cane by Seasons in Relation to Density and Height of Cane and Tree Cover, and Response of Switch Cane to Utilization at Different Seasons.

(Subproject Number 12)

Purpose:

The purpose of this study is to obtain information vital to the development of a range appraisal method and useful for developing management systems for the switch cane forage type. The specific aims are to determine (1) forage productivity (in cow days of grazing) and forage quality (as indicated by chemical analysis) at five different seasons in relation to density and height of cane; (2) response of switch cane to heavy utilization at these five seasons as reflected in cane vigor and forage production during successive years; (3) the effect that tree cover may have on (1) and (2).

Importance and Scope of Study:

Efficient management of native range involves, first, the determination of the amount of available forage, or grazing capacity, and second, the application of grazing systems which will most nearly produce the results desired. Usually the objective is maximum beef production and a sustained forage yield. In some instances, however, it may be preferable to partially destroy the forage resource, and perhaps sacrifice something in cattle gains, in order to obtain other benefits such as fire control, increased pine reproduction, hardwood control, etc.

To date, no evaluation factors have been devised for determining grazing capacity of switch cane range with any precision. From long experience, the capacity of the highly productive experimental ranges at Wenona have been quite accurately determined. At Hofmann Forest, however, the capacity of the experimental ranges was over-estimated at the beginning of the study and the stand of

switch cane was severely damaged before the situation was corrected. Hence, there is no standard of correct utilization for medium and small cane such as occur at Hofmann Forest and generally throughout the pond pine forest type.

The orthodox method is to determine grazing capacity from a range survey, or inventory of kinds and amounts of grazable forage. The "amounts" are sometimes estimated in units of weight, but usually they are expressed in terms of "density", or ground cover, which has been found to be a usable and rapid method of forage appraisal on native ranges. Certain "productivity" factors are then applied in order to convert the density data to grazing capacity. These productivity factors are intended to express the relative amounts of usable forage represented by a unit of density of the various forage species. For example: If the productivity factors, or ratings, of species A and species B were 40 and 80, respectively, then a unit of density (a square foot, acre, etc.) of species A would represent one-half as much usable forage as would a unit of species B. Such factors or ratings may vary with seasons. Some species, for instance, are not usable in winter and others are grazed only during the spring. For switch cane, at least, the ratings may require adjustment for the size of the plants. Forage quality and also productivity per unit of density appear to be correlated with cane height which in turn, probably reflects site quality.

A first step in developing factors for the calculation of grazing capacity of switch cane ranges from forage surveys is to determine the gross forage production in terms of cow days or months of grazing per unit of foliage density. This should be determined by seasons corresponding to growth habits and forage characteristics of the species. The relation of height of cane to productivity should be established also. The relationship of density to forage yield (by weight) can be determined by clipping or plucking the forage from plots on which density estimates have been made. This determination offers another approach to

the grazing capacity problem and also provides a check on the accuracy of the "density estimation" technique as applied to range appraisal. After factors expressing the relationship of foliage density and cane height to forage yield and grazing capacity are determined, they can be adjusted for correct utilization, or "proper use", when the latter is determined from further studies.

Heavy utilization for a short period, amounting to almost complete defoliation during a restricted season, should reveal the season or seasons when switch cane is vulnerable or resistant to grazing. The problem will then be to determine the degree of utilization this species will tolerate during the periods when it is sensitive to over-use. In previous studies this species has been grazed during either the entire summer or winter seasons. Winter grazing has not reduced the vigor and productivity of the cane stand appreciably. Continuous heavy summer grazing has seriously damaged this species in two or three years. Since the summer grazing season has extended from May until September or December, it has not been possible to determine whether or not switch cane is particularly susceptible to grazing damage during certain portions of that period. Limited facilities preclude the investigation of different degrees of utilization in this study at the present time.

A good opportunity to investigate the effect of tree cover on grazing capacity and tolerance of utilization is offered at the Tidewater Station where cane stands occur both in forested sites and in open sites without trees.

Status:

This is a new subproject.

Methods and Procedure:

Treatments:

Practically complete utilization of foliage of switch cane of different heights during each of the following periods:

1. May - June (active growth stage)
2. July - August (late growth and early full leaf stage)
3. Sept. - Oct. (mature leaf stage)
4. Nov. - Dec. - Jan. (early winter)
5. Feb. - Mar. - Apr. (late winter - before spring growth)

Conditions:

Trees vs. no trees: The study will be conducted both on a site having a fairly dense stand of young pond pine trees (20 to 30 feet tall) and on an open site with no tree overstory.

Cane height and density: The paddocks will be so located that the average density and average height of switch cane will vary considerably between paddocks but will be as uniform as practicable within paddocks.

Size and number of range paddocks:

2 reps. (10 paddocks) under trees

2 reps. (10 paddocks) in the open (no trees)

Each paddock one acre in size.

Location of paddocks and treatment assignment:

The paddocks under trees will be located in Tiers 1 and 2 of Block J; those without trees will be located in Tiers 2 and 3 of Block K of the Tidewater Experiment Station. Within each of the two conditions, trees vs. no trees, the treatments and replications will be assigned at random, disregarding cane density and height effects which

will be evaluated by the application of covariance analysis.

Small plots:

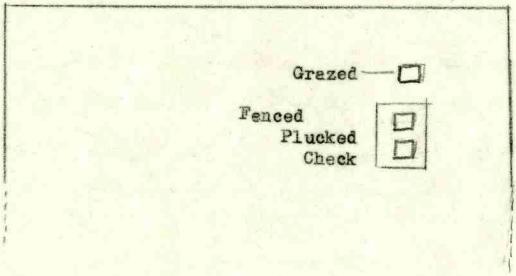
Small plots, initially comparable, as to density and size of switch cane enclosed, will be staked out in triplicates within each paddock on an area having forage and tree conditions representative of the paddock. Two of these plots will be protected from grazing by a fenced enclosure; the third will be open to grazing. One of the fenced plots will be plucked by hand, at the time the cattle are removed, to simulate the degree of utilization of the grazed plot (and the paddock).

These small plots are not intended to sample the paddocks (which will be carefully surveyed by other methods), but are being used to evaluate some of the results through precise measurements which would not be feasible on the entire paddock. Specifically, the small plots will provide an estimate of: (a) yearly variations in forage growth (fenced plots), (b) cumulative effects of the grazing treatments (fenced plots vs. grazed plots), (c) trampling and breaking effects on cane involved in grazing as against merely utilization effects (grazed vs. plucked plots), (d) forage yield, (by weight) from year to year under the five "treatments" as related to density and height of cane (plucked plots), and (e) the accuracy of the density estimate method as a means of estimating grazing capacity. For this last purpose (e) the plucked plots in the paddock enclosures will be supplemented by plucking 10 additional plots of ungrazed cane of various heights to better determine the regression of density and height on forage yields.

Figure 1. Diagram illustrating the design and showing a random assignment of grazing periods and replications. The shape of individual paddocks may be altered slightly so that, for both tree conditions, some paddocks will contain relatively short cane and others tall cane.

Trees		No Trees	
May-June	July-Aug.	Nov.-Dec.-Jan.	July-Aug.
Sept.-Oct.	Feb.-Mar-Apr.	May-June	Feb.-Mar-Apr.
July-Aug.	Nov.-Dec.-Jan.	Sept.-Oct	Feb.-Mar-Apr.
May-June	Sept.-Oct.	Nov.-Dec-Jan.	Sept-Oct.
Feb.-Mar-Apr.	Nov.-Dec.-Jan.	May-June	July-Aug.

Figure 2. Diagram of small plots in a single paddock. These plots, in triplicate, will be located in an area selected as representative of the forage conditions in the paddock.



The size of the small plots will be 3.1 x 3.1 feet. This size permits convenient access to the entire plot from the edges and also simplifies conversion of forage yields per plot to pounds per acre (grams per plot x 10 = pounds per acre).

Number of cattle and method of grazing:

Stocking will be at the rate of two cows per paddock, a total of only eight cows will be required since only one paddock of each replication will be grazed concurrently. Mature cows, comparable in condition and without calves at their side, will be used if possible. Pairing will be at random unless there is considerable variation in size, in which case light cows will be paired with heavy cows. The pairings will be maintained, and cows will continue on the same tree conditions (trees vs. no trees), for a complete grazing cycle (one year). Within the tree conditions, assignment to replications will be at random.

The cattle will be turned into appropriate paddocks early enough in the designated grazing period to insure that the cane foliage will be fully utilized before the end of the period. When the paddocks have been utilized to the point where the cows fail to obtain a "fill", the cattle will be removed and held on auxiliary switch cane range until time to begin the next grazing period. Grazing will begin in May after the cane has put out two or three full leaves. It is anticipated that any one of the paddocks will support the two cows for two to six weeks. The grazing will be done near the middle of each of the five grazing periods. During the winter the cows will be fed one or two pounds of protein supplement (cottonseed or soybean meal) because switch cane forage is deficient in protein at this season.

Records and Measurements:

Paddocks:

Forage surveys will be made of each paddock at beginning of study to determine botanical composition of vegetative cover and especially the density and height of switch cane. For this purpose, each paddock will be sub-divided into 8 to 10 portions, and a forage write-up made for each separate portion. These will be combined to obtain the average for a paddock. Grazing dates will be recorded for each paddock.

Degree of utilization will be estimated for each paddock when the cows are removed.

Photo stations will be established in one replication of paddocks (10 total). These will be photographed before and after grazing each year.

Plots:

On each plot the following records will be made at the beginning of the study, and each year thereafter (during the full leaf stage of growth):

Foliage density

Number and size of cane stalks

Number and size of new basal shoots

Average number of branches per stalk and leaves per branch

Average size of leaves

In addition, forage yield (converted to dry weight) will be recorded for the plots harvested by hand during each grazing period.

Amount of regrowth after utilization will be noted periodically and at the end of the growing season.

Supplementary data:

Samples of cane rhizomes and stalks will be collected from each paddock for carbohydrate analyses at the close of the study and possibly at the end of each season.

A sample of cane forage for feed analyses will be collected from each paddock while the paddock is being grazed.

The cattle will be weighed as they are turned in and taken out of the paddocks. A check group of about four cows, grazed on abundant cane forage, will be weighed at the same times.

Initiation and Duration:

The study will be started in May 1948 and will continue for at least three full seasons.

Statistical analysis:

For grazing capacity of the paddocks in cow days the analysis for one year will be:

Source	d.f.
Trees vs. no trees (T)	1
Reps. within T (error a)	2
Seasons of utilization (S)	4
S x T	4
S x Reps. within T (error b)	8
Total	19

The regression of grazing capacity on Height and Density of cane ~~on grazing capacity~~ will be determined; also, the partial regression of "forage other than cane" will be included ~~accounted for~~ if this proves to be important, leaving five degrees of freedom for the final error term.

The effect on grazing capacity of utilization at different seasons will be reflected by the analysis given above during successive years. The small plot data will give supplemental information on items affecting grazing capacity. Such items as number and size of new shoots, and number and size of leaves reflect the vigor of the switch cane as affected by season of utilization. These items, or others measured on the small plots, can be analyzed independently (for example, forage yield on plucked plots) or as paired comparisons (grazed vs. check plots, grazed vs. plucked plots, etc.).

Two examples of the small plot analyses (for one year) follow:

A. Forage yield from plucked plots:

Source	d.f.
Trees vs. no trees	1
Season of grazing	4
Trees x Season	4
Reps. within Trees x Season (error)	10
Total	19

Regression of Density and Height ~~on~~ yield on will reduce the degree of freedom for error to 8.

B. Difference in number of new shoots on grazed plots vs. check plots:

Trees vs. no trees (T)	1
Season of Grazing (S)	4
T x S	4
Reps. within T x S	10
Grazed vs. check (G)	1
G x T	1
G x S	4
G x T x S	4
G x Reps. within T x S	10
Total	39

The regression of other factors, such as number and size of stalks, foliage density, etc., which may affect the number of new shoots, can be investigated by utilizing 1 d.f. for each factor.

The effect on grazing capacity of utilization at different seasons will be reflected by the analysis given above during successive years. The small plot data will give supplemental information on items affecting grazing capacity. Such items as number and size of new shoots, and number and size of leaves reflect the vigor of the switch cane as affected by season of utilization. These items, or others measured on the small plots, can be analyzed independently (for example, forage yield on plucked plots) or as paired comparisons (grazed vs. check plots, grazed vs. plucked plots, etc.).

Two examples of the small plot analyses (for one year) follow:

A. Forage yield from plucked plots:

Source	d.f.
Trees vs. no trees	1
Season of grazing	4
Trees x Season	4
Reps. within Trees x Season (error)	10
Total	19

Regression of Density and Height ~~on yield~~ yield on will reduce the degree of freedom for error to 8.

B. Difference in number of new shoots on grazed plots vs. check plots:

Trees vs. no trees (T)	1
Season of Grazing (S)	4
T x S	4
Reps. within T x S	10
Grazed vs. check (G)	1
G x T	1
G x S	4
G x T x S	4
G x Reps. within T x S	10
Total	39

The regression of number on other factors, such as number and size of stalks. foliage density, etc., which may affect the number of new shoots, can be investigated by utilizing 1 d.f. for each factor.

Note: Dr. H. L. Lucas of the Institute of Statistics, N. C. State College, has approved the design of this study from the statistical point of view and has suggested the statistical analyses presented here.

Equipment and Material Required:

Fencing: Approximately two miles of fence line; 24 rolls of barbed wire (for three strands); and almost 700 posts (at 15' intervals). The post requirement could possibly be reduced by at least one-fourth by attaching wire to standing trees.

Other Equipment: Watering facilities will be needed for eight cows in four groups; including four watering tubs and four hand pumps or six shallow open wells.

Wintering Yearling Heifers on Forest Range

(Subproject Number 13)

The purpose of this study is to obtain information concerning the winter feeding of concentrates to yearling heifers ranged on medium quality reed type forage. The specific aims are to determine (1) the amounts of supplemental feed required to maintain yearling heifers at two levels of nutrition during the wintering period and (2) the effect of varying nutritional levels during the winter on subsequent growth and conception the following season.

Importance of Study:

The wintering of beef cattle on the farm is the most expensive period of the year. Previous studies have indicated the economy effected by wintering cattle on reeds instead of harvested roughages in eastern North Carolina. However, while the winter feed cost can be greatly reduced by the use of reeds, the method has proven costly to producers that failed to properly supplement the forest range with appropriate concentrate feeds which has been reflected in high death losses and reduced calf crops.

Previous studies with mature cows and also forage analyses have shown that reeds alone are inadequate as a source of winter feed. Furthermore, it has been demonstrated that young animals are less adapted to utilize the coarse forest forage. Although the forage quality of forest range continuously grazed undoubtedly deteriorates as the wintering period progresses, all previous studies have been conducted furnishing a constant amount of concentrates. It seems highly desirable to determine the amount of supplement required to maintain a specific nutritional level. Also information is needed relative to the effect of different nutritional levels during wintering on subsequent performance under a system of forest grazing.

Status:

This is a new subproject. Previous wintering trials in this area (Subproject No. 5) have been concerned with mature cows and at constant rates of supplemental feeding.

Methods and Procedure:

Nutritional Levels:

Group I. Wintered to approximately maintain fall weights. (Nov. 15 weights).

Group II. Wintered to maintain daily gains of about 3/4 pound per head.

Cattle:

Yearling heifers produced and developed on forest range will be divided into two groups, of about 15 animals, comparable as to breeding, previous treatment and performance. For the immediate future heifers produced under subproject No. 8 and consisting of grade Herefords, Brahman x Hereford and Africander x Hereford will be included.

Feeding and Management:

1. The wintering period will extend from mid-November through April.
2. Cattle will be weighed at the beginning and at 14-day intervals throughout the wintering period.
3. The two groups will be grazed separately and alternated between ranges at two-week intervals to minimize effects of pasture differences.

For the initial 14-day period no supplemental feed will be given. Thereafter feed will be supplied to the respective groups as necessary to maintain the specified rates of gain. Adjustments in rate of supplemental feeding will be made only on weigh days and will be based on performance during the preceding period.

4. Cottonseed meal will be used as the only source of concentrates for rates of feeding up to two pounds per head per day. Additional requirements will be supplied through the use of ground corn.

Winter Range:

1. The first test will be conducted at the "logged pastures", in the Hofmann Forest.

Further tests can be made at Hofmann Forest or at any other suitable location in the reed forage type.

Records:

1. Heifers will be graded and scored according to thrift and condition at the beginning and close of the wintering period.
2. Heifers will be weighed at the end of the summer grazing period to determine the effects of wintering on subsequent gains.
3. Detailed records will be maintained relative to dates of conception, percentage calf crop, and weight of calf at birth and weaning through the first two years in the herd and longer if deemed necessary at that time.
4. Complete daily feed records will be kept on each group throughout the wintering period.

Statistical Analysis:

Cattle (for one year)

Source of variation	d.f.
Between groups	1
Heifers in groups	N-2
Total	N-1

Initiation and Duration: This subproject was begun in 1947 and will continue for three or more years.

Dr. Hilton's Office Copy-

FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: Utilization of Reeds in Forest Grazing- Phase I.B, Creep Feeding Calves. P.14-Ai3 - Purnell

2. Departments and cooperating agencies: Animal Industry; N. C. Dept. of Agr.; Bureau of Animal Industry, U.S.D.A., and U. S. Forest Service.

3. Major personnel: J. E. Foster, H. H. Biswell, and Earl H. Hostetler.

4. Date begun: June 19, 1941 Date revised/completed: May 1946
If discontinued without completion state reasons:

5. Estimated total cost by funds (salaries and maintenance): Purnell $5000.00

6. The problem (briefly restate its nature, importance, and economic significance):

To determine the value of creep feeding calves on reed pastures to weaning age, and to compare this with the value of running calves on reed pastures in the early part of the season and then transferring them to lespedeza pasture until weaned (to be done at the Blackland Test Farm).

An increasing number of breeders are marketing their cattle chiefly as weaned calves, feeling that it is more profitable to keep larger cow herds and thus sell more calves. This being the case, many beef producers are interested in the production of weaned calves and desire information on the values of supplemental feeding. Supplementary feeding of calves on forest range, through either creep feeding or improved pastures, offers possibilities of economically increasing meat and hide production in this area.

7. Major results and conclusions:

In these tests creep feeding during the summer on good native range in the Coastal Plain did not prove worthwhile. The calves would not eat the supplement satisfactorily, and their increased gains in weight and condition were not sufficient to pay for the feed consumed and the labor involved.

Lespedeza pastures produce good calf gains and can be grazed to good advantage in late summer. They should be more widely used.

Whether the results of creep feeding nursing calves are favorable or unfavorable depend very largely, it seems, on the forage and on the supply of milk. When the forage is poor in quality, is grazed too close, or if the cows are poor milkers, the calves can be expected to eat more supplement and make better gains than where the forage is good and milk supply plentiful.

* Two copies to be sent to the Office of Experiment Stations.

8. Practical applications and public benefits achieved or in prospect:

There are over nine million acres of forest land in the Coastal Plain region of North Carolina. Forest land grazing in this area makes up 29% of the yearlong keep of beef cattle and reeds are the most important source of native forage.

Creep feeding under these conditions did not increase the weights or finish of the calves enough to offset the cost of grain consumed and the extra labor involved. This is especially important at the present time when there is a scarcity of both meat and concentrate feeds. A calf creep-fed from May 1 to November 15 will consume approximately 600 pounds of concentrates. In a herd of fifty calves this would be a saving of fifteen tons of concentrates.

9. Publications:

A manuscript on Grazing and Creep Feeding Studies on Reeds has been completed and is ready for publication.

Director

Office Copy for Dr. Hilton

FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: Utilization of Reeds in Forest Grazing- Phase I.A. Rotational Grazing. P.14-Ai3 - Purnell

2. Departments and cooperating agencies: Animal Industry; N. C. Dept. of Agr., Bureau of Animal Industry, U.S.D.A., and U. S. Forest Service.

3. Major personnel: J. E. Foster, H. H. Biswell, and Earl H. Hostetler.

4. Date begun: June 19, 1941 Date revised/completed: May 1946
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5. Estimated total cost by funds (salaries and maintenance): Purnell $5000.00

6. The problem (briefly restate its nature, importance, and economic significance):
To compare the practice of continuous grazing of the reed forage type with the practice of rotating one time during the season and with rotating every 28 days (to be done at Blackland Test Farm).

Past experiments on beef cattle production in the reed forage type, together with general observations, show that reeds may be easily killed by continuous heavy spring grazing. Further, these studies and observations show that cattle usually make satisfactory gains on this type of forage until about the first of August, but for the remainder of the season the rate of gain usually drops to less than half and is not considered satisfactory. To best use this type of range for sustained forage yield and for better cattle gains after the first of August, more information is needed on different management practices.

7. Major results and conclusions:
In the four trials rotational grazing of beef cattle on reed pasture showed no advantage over continuous grazing.

Continuous grazing was compared with changing to ungrazed pastures on approximately August 1, and with rotating between two pastures every 28-day weigh period until the close of the grazing season. The pastures were grazed at the rate of three acres per yearling from about May 10 to November 15. Six groups of ten steers or heifers each, were used in all trials.

The results of this experiment show that livestockmen would not be justified in the extra expense of fencing and management necessary to provide rotational grazing in reeds during the growing season. Previous tests at this Station, though, brought out the necessity of rotating between summer and winter reed ranges.

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These studies showed that continuous grazing, from the standpoint of both cattle gains and condition of pastures, was equal to monthly or mid-season rotation. This would mean a vast saving in cost of extra fencing, watering and other facilities and labor required for rotational grazing. Fencing alone at present prices, even in this area where posts can be driven, costs $350.00 per mile.

9. Publications:

A manuscript on Rotational Grazing on Reeds has been prepared and should be ready for publication at an early date.

_____

Director

North Carolina State College of Agriculture and Engineering
of the
University of North Carolina
Raleigh
STATE COLLEGE STATION

SCHOOL OF AGRICULTURE AND FORESTRY
AGRICULTURAL EXPERIMENT STATION
AGRICULTURAL EXTENSION SERVICE
RESIDENT TEACHING

DEPARTMENT OF ANIMAL INDUSTRY

April 12, 1948

Dr. D. W. Colvard
Animal Industry Dept.
Campus

Dear Dr. Colvard:

Since it has been decided that we will abandon our Forest Grazing work at the Hofmann Forest it would seem advisable that we move the cattle on or about May 1 to Wenona and hold them there until a new Forest Grazing Area is selected, which we believe can be done by this fall.

The principal reasons for suggesting the move now rather than later are as follows:

1. At Wenona the grazing is much superior to that at Hofmann Forest.

2. At Wenona there are 12 pastures of 15 acres each and 4 pastures of 40 acres that will greatly facilitate breeding the several different groups of cows this spring.

3. The monthly expense at Hofmann Forest is now approximately $365.(1) This can be reduced at least $200 if the cattle are moved to Wenona early in May.

It will be appreciated if you will let me have your decision on this as early as possible so that we can plan accordingly.

Very truly yours,

Earl Hostetler

E. H. Hostetler
Professor and Head
Animal Husbandry Section

Forestry Dept of School of Agr.

(1) Salaries 150
Travel 80
Rent (calves) 135
Total $ 365

Decision to move out does not preclude possibility of returning if / when conditions are such that work can be carried out.

file

North Carolina State College of Agriculture and Engineering
of the
University of North Carolina
Raleigh

SCHOOL OF
AGRICULTURAL AND FORESTRY
RESEARCH EXTENSION
RESIDENT TEACHING

AGRICULTURAL EXPERIMENT STATION

OFFICE OF DEAN AND DIRECTOR

November 18, 1947

MEMORANDUM TO: James H. Hilton

Just for the records, this is to advise that the following committee has been appointed to handle the selection of the forest grazing site in Eastern Carolina:

I. H. Sims, U. S. Forest Service, Chairman
W. O. Shepherd, U. S. Forest Service
E. H. Hostetler, Animal Industry
H. A. Stewart, Animal Industry
Clemens Kaufman, Forestry

Very truly yours,

L. D. Baver

L. D. Baver
Dean and Director

LDB:H

file

North Carolina State College of Agriculture and Engineering
of the
University of North Carolina
Raleigh

SCHOOL OF AGRICULTURE AND FORESTRY
AGRICULTURAL EXPERIMENT STATION
AGRICULTURAL EXTENSION SERVICE
RESIDENT TEACHING

STATE COLLEGE STATION

DEPARTMENT OF ANIMAL INDUSTRY

June 7, 1947

Dr. J. H. Hilton
Head, Animal Industry
Polk Hall, Campus

Dear Dr. Hilton:

I am enclosing herewith final reports for Rotational Grazing, Phase 1 A, and Creep Feeding Calves, Phase 1 B, under Purnell Project P14-ai3, Utilization of Reeds in Forest Grazing.

Very truly yours,

Faye Hostetler

E. H. Hostetler
Professor and Head
Animal Husbandry Section

Enc.

FINAL REPORT, COMPLETED OR REVISED PROJECTS

North Carolina Agricultural Experiment Station

1. Project title, number, and fund: Utilization of Reeds in Forest Grazing - Phase I.A. Rotational Grazing. P.14-A13 - Purnell

2. Departments and cooperating agencies: Animal Industry; N. C. Dept. of Agr., Bureau of Animal Industry, U.S.D.A., and U. S. Forest Service.

3. Major personnel: J. E. Foster, H. H. Hilwell, and Earl H. Hostetler.

4. Date begun: June 10, 1943 Date revised/completed: May 1946
If discontinued without completion state reasons.

5. Estimated total cost by funds (salaries and maintenance): Purnell $5000.00

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The results of this experiment show that livestockmen would not be justified in the extra expense of fencing and management necessary to provide rotational grazing in reeds during the growing season. Previous tests at this Station, though, brought out the necessity of rotating between summer and winter reed ranges.

* Two copies to be sent to the Office of Experiment Stations.

8. Practical applications and public benefits achieved or in prospect:

There are over nine million acres of forest land in the Coastal Plain region of North Carolina. Forest land grazing in this area makes up 25% of the yearlong keep of beef cattle and reeds are the most important source of native forage.

These studies showed that continuous grazing, from the standpoint of both cattle gains and condition of pastures, was equal to monthly or mid-season rotation. This would mean a vast saving in cost of extra fencing, watering and other facilities and labor required for rotational grazing. Fencing alone at present prices, even in this area where posts can be driven, costs $350.00 per mile.

9. Publications:

A manuscript on Rotational Grazing on Reeds has been prepared and should be ready for publication at an early date.

DIRECTOR

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1. Project, tile, number, and fund: Utilization of Reeds in Forest Grazing - Phase I.B. Creep Feeding Calves. P.14-Ai3 - Purnell

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3. Major personnel: J. E. Foster, H. H. Biswell, and Earl H. Hostetler.

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Lespedeza pastures produce good calf gains and can be grazed to good advantage in late summer. They should be more widely used.

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8. Practical applications and public benefits achieved or in prospect:

There are over nine million acres of forest land in the Coastal Plain region of North Carolina. Forest land grazing in this area makes up 20% of the yearlong keep of beef cattle and reeds are the most important source of native forage.

Creep feeding under these conditions did not increase the weights or finish of the calves enough to offset the cost of grain consumed and the extra labor involved. This is especially important at the present time when there is a scarcity of both meat and concentrate feeds. A calf creep-fed from May 1 to November 15 will consume approximately 600 pounds of concentrates. In a herd of fifty calves this would be a saving of fifteen tons of concentrates.

9. Publications:

A manuscript on Grazing and Creep Feeding Studies on Reeds has been completed and is ready for publication.

DIRECTOR

New Projects

Report of Conference April 1, 1947, concerning Forest Grazing Projects at Hofmann Forest.

Present: J. E. Foster, H. A. Stewart, W. O. Shepard and E. H. Hostetler.

A - It is the feeling of those in charge of the work at Hofmann Forest that:

1. That anticipated results do not justify the continued expenditure of approximately $10,000 per year.

2. That the expense necessary to continue new and revised projects at the Hofmann Forest will be as great or greater than at a new location which will be more typical of the area and will yield more valuable experimental data.

B - It is agreed that the following procedure will be followed:

1. That during the period May 5 to 15, 1947, that Messrs. Foster, Stewart and Shepard will investigate possibilities for a new location.

2. That about May 1, 1947 all cattle at Deppe, except those in C pasture, will be moved to Comfort. The cows and two-year old heifers will be divided into four groups for breeding. The yearling heifers at Comfort will be moved to the reed area back of the Deppe fire tower.

3. That about August 1, 1947 all unsuitable cows and heifers will be sold.

4. That about August 1, 1947, all cows and calves at Comfort will be moved to reed area back of Deppe fire tower.

5. That about November 15, 1947, when calves are weaned, all cattle that can not be cared for at Comfort will either be sold or moved to a new location.

6. That about November 15, 1947, all cattle work at Deppe, including mineral experiment in C pasture, will be discontinued unless it is necessary to hold some of the cattle there temporarily and later move them to a new location.

7. That the forest grazing projects at Hofmann Forest will be revised so that they can be carried out at Comfort with the facilities and labor (Nash Thomas)

now available and on federal funds alone (about $5500 annually).

8. That Dr. Hofmann be requested to take over the salary of Charlie Carter beginning 7-1-47. If he agrees to do this, some of the changes indicated may be revised.

C - Numbers of cattle now at Hofmann Forest and owned by Animal Husbandry Section of Animal Industry department.

1. At Deppe (to be moved to Comfort May 1) 67 cows, 22 two-year old heifers.

2. At Deppe (C pasture) 22 cows.

3. At Comfort, 41 yearling heifers, 9 bulls.

4. At Kit's Island (unable to get out)

22 cows, 2 two-year-old heifers and 4 yearlings.

May 31, 1945.

Dr. L. D. Baver, Director,
Agricultural Experiment Station,
State College Station,
Raleigh, N.C.

Dear Dr. Baver:-

This is to advise that members of the Forestry and Animal Industry Departments met last Monday to discuss the mutual problems in connection with the grazing projects on the Hofmann Forest. After a rather complete discussion of these problems the attached agreements were worked out and agreed upon by the two departments. If these meet with your approval we shall proceed in accordance with these mutual understandings.

Yours very truly,

J. H. Hilton, Head,
Department of Animal Industry.

Enclosure.

COPY

State College Station,
Raleigh, N.C.
May 29, 1945.

Dr. J. V. Hofmann
Ricks Hall
Campus

Dear Dr. Hofmann:

It is my understanding from our conference in Dr. Hilton's office yesterday that we will continue with the cattle work at the Hofmann Forest on the same basis as formerly which is briefly:

1. That the Forestry department provide roads and trails to cattle pastures.

2. That the Forestry department aid with equipment and labor in building such fences, feed barns and wells as may be needed to successfully carry out the approved Forest Grazing projects.

3. That the Animal Industry department (A.H. Section) pay the Forestry department, each autumn after the calves are weaned, one-half the value of all calves produced on the Hofmann Forest that year.

4. That all of the administrative work on the Hofmann Forest be under the general supervision of the Supervisor and, that until some one can be employed to have immediate supervision of the Forest Grazing projects, the present herdsmen will do such work as seems necessary for the furtherance of the program when their efforts are not needed on the Forest Grazing projects.

It was agreed in conference that the following matters would be undertaken in the near future and would be completed by October 1, 1945:

1. That approximately ten miles of barbed wire fence (4 strands, posts 12 feet apart) be erected around the reed area northwest of the Deppe tower. The Forestry department to furnish equipment, labor and posts, and the Animal Industry department to furnish the wire for building this fence.

2. That the trail, northwest from the Deppe tower to the pump and feed barn, be improved so as to be passable for moving feed and cattle during the winter months.

3. That the Forestry department provide galvanized iron roofing, immediately, for the cattle barn at Cypress Creek and that Messrs. Thomas and Craft erect this material as rapidly as their other duties will permit.

It will be appreciated if you will make any suggestions or revisions you think necessary and return to me in order that these suggestions may be sent to each one concerned.

Very truly yours,

(Signed) Earl H. Hostetler,
Professor and Head, A. H. Section,
Associate in Animal Industry.

Approved May 30, '45
(Signed) J. V. Hofmann.

A. O. Shaw

Office Copy —— Do not Take out.

THE ROLE OF FOREST GRAZING IN BEEF CATTLE PRODUCTION IN THE SOUTHEASTERN UNITED STATES

PROJECT ANALYSIS AND REVISED WORKING PLANS FOR STUDIES IN THE COASTAL PLAIN OF NORTH CAROLINA

- June 20, 1942 -

A cooperative project of the Divisions
of Animal Husbandry, Forestry, and Agronomy of the
Agricultural Experiment Station of the North
Carolina State College of Agriculture
and Engineering
the
North Carolina Department
of Agriculture
and
The Forest Service and Bureaus of Animal
Industry and Plant Industry of the United States
Department of Agriculture

FOREWORD

General aims of this project analysis and working plan are as follows:

1. To provide a thorough understanding of the problems of forest grazing in this area and their importance and scope.

2. To insure a thorough-going attack on the problems.

3. To guide the execution of the work and insure that pertinent data are collected regardless of change in personnel or change in viewpoint of existing personnel.

4. To inform station directors, chiefs, and heads of divisions of methods of attack and how the work is being done.

5. To serve as a basis for the preparation of reports and publications.

It is proposed that the working plans be rigid enough to insure that the original intent is attained, yet general and flexible enough to permit necessary revision and the investigation of "sidelight" problems. As the work progresses and more information is obtained, it will be necessary to make certain changes in technique, but no changes should be made before seeing whether such changes can be incorporated successfully without endangering the primary objectives of the studies. Minor changes may be approved by the project leaders who are responsible for the technical phases of the studies, but any necessary major changes should be approved also by station directors, chiefs, and heads of divisions of the various cooperating agencies. All changes should be in the form of written supplements.

The subprojects herein outlined have been reviewed by representatives of all cooperating agencies and general approval obtained. Professors Gertrude M. Cox and J. A. Rigney of the Statistical Section of the North Carolina State College have considered and approved all subprojects from the statistical point of view and have suggested and written out the analyses presented.

As certain of these subprojects are completed working plans will be developed for others.

CONTENTS

THE ROLE OF FOREST GRAZING IN BEEF CATTLE PRODUCTION IN THE SOUTHEASTERN UNITED STATES

PROJECT ANALYSIS AND REVISED WORKING PLANS FOR STUDIES IN THE COASTAL PLAIN OF NORTH CAROLINA

By

J. E. Foster, North Carolina Experiment Station and Bureau of Animal Industry, United States Department of Agriculture

and

H. H. Biswell, Appalachian Forest Experiment Station, Forest Service, United States Department of Agriculture

INTRODUCTION

General observations as well as the experiences of many stockmen indicate that cattle raising and timber production fit very well together on many forest areas in the southeastern United States. This is the case on cutover lands, particularly, where the raising of beef cattle furnishes some annual income to the farmer while the trees are growing to merchantable size; furthermore, the grazing affords protection to the trees through reducing the forest fire hazard. Some studies started recently in the Coastal Plain are planned primarily to determine how timber production and cattle grazing can be most satisfactorily fitted together. The development of improved practices and the proper correlation of the grazing of forest lands with that of tame pastures, field crops, and feeds, together with improved livestock management, afford a possibility of deriving greater returns from these lands than from the growing of timber alone or the production of beef alone.

The studies are located in the Coastal Plain of both North Carolina and Georgia and are conducted by state and federal agencies cooperating. The analysis and working plans presented here are for the experiments

in North Carolina and are based largely on present conditions and practices in this area. To arrive at the major objective set forth, the fields of animal husbandry, range management, forestry, soils, farm crops, economics, and perhaps others, should be drawn upon.

The studies are especially important at this time because they deal with vital necessities for the war -- timber products and meat and hides. The present demand for these in the southeastern states is great because of the concentration of army camps in this area. Many forest areas are being heavily cut and the acreage of cutover land to be managed is rapidly increasing. Most cattle products of course have to be shipped in. With transportation facilities harder pressed all the time, it is still more important that as much of these necessities as possible be grown or produced in this area. These studies will also have importance during the post-war period, especially because of the greater acreage of cutover lands to be managed.

CONDITIONS AND PRACTICES IN FOREST RANGE MANAGEMENT IN THE COASTAL PLAIN OF NORTH CAROLINA

The statements in this section are based largely on a survey of forest grazing in the Coastal Plain of North Carolina made, in the fall and winter of 1940-41, primarily to learn more specifically about present methods of handling beef cattle herds and forest grazing lands in this area. Also, to find the results obtained by operators, and to discuss with them their experiences and chief problems in raising cattle and growing trees on the same land. The results of this survey are presented here briefly, so as to make this project analysis more complete. They are presented in more detail in bulletin form (3).

General Description of the Coastal Plain of North Carolina

The Coastal Plain of nearly 15 million acres includes 44 counties in the eastern part of the state. It is primarily a forest and farm region, with forest lands comprising 64 percent of the unit (5, 6). The eastern one-third, commonly called the Tidewater Section, is a low, level, poorly drained area characterized by extensive swamps and sluggish rivers. The other portion, the western Coastal Plain, with a gently rolling topography, is well drained, but, because none of the slopes are very steep, soil erosion generally is not a serious problem. The five main forest types in the Coastal Plain and the approximate percentage of each are the loblolly pine-hardwood, 43 percent; bottomland hardwood, 22 percent; pond pine-hardwood, 21 percent; longleaf pine, 8 percent; and upland hardwood, 6 percent. Many forests have an undesirable, almost impenetrable brushy undergrowth, and therefore are

not well suited to grazing. The main brush species here are gallberries (Ilex spp.), waxmyrtles (Myrica spp.), bays (Magnolia virginiana, Persea pubescens, and Gordonia lasianthus), huckleberries (Vaccinium spp.), laurels (Kalmia spp.), and species of Smilax (Smilax spp.).

Agriculture is the leading industry in the Coastal Plain, with the important cash crops consisting of tobacco, cotton, corn, peanuts, and potatoes. The acreage of certain of these has decreased in the past few years and that of small grains, hays, and tame pastures has increased. This change has favored cattle production.

Forage Types

The forage available for grazing in the forest areas of the Coastal Plain of North Carolina can be classed in five generalized types on the basis of the most abundant palatable plants present. The generalized types and the approximate percentage of each are the reed, 30 percent; woodsgrass, 30 percent; broomsedge, 25 percent; wiregrass, 14 percent; and marshgrass, 1 percent. In some places, of course, it is difficult to classify the forage on this basis because the dominant species of two or more types may be present in about equal abundance.

As far as cattle grazing is concerned, the reed type is the most important and most extensively used. Also, the possibilities for expanding forest grazing in the Coastal Plain appear to be greatest in this type because there are large areas of it not being grazed at present. Areas of reeds apparently have been greatly reduced in size in the past because of overgrazing and fires (10). Proper management of reed areas for sustained forage yield is a problem that should be studied. The comparative amounts of grazing furnished at present by the different forage types are approximately as follows: reed, 46 percent; woodsgrass, 18 percent; broomsedge, 33 percent; wiregrass, 2 percent; and marshgrass, 1 percent. The reed type is suitable for grazing practically all of the year, whereas the woodsgrass, broomsedge, and wiregrass types are good for only spring and early summer grazing, and the marshgrass type mainly for winter. While some of these can not be used very long each year, they usually furnish grazing at a time when other feeds are scarce and for this reason are more important than the length of their use indicates.

Some of the main forage species in the different types are as follows: reed type -- reed (Arundinaria tecta) and Panicum grasses (Panicum spp.); woodsgrass type -- bluestems (Andropogon spp.), Panicum grasses, and sedges (Carex spp.); broomsedge type -- yellowsedge bluestem (Andropogon virginicus), and other bluestems; wiregrass type -- threeawns (Aristida spp.), muhly grasses (Muhlenbergia spp.), and dropseeds (Sporobolus spp.); marshgrass type -- rushes (Juncus spp.) and salt-tolerant grasses.

Browse Plants and Poisonous Plants

Several vines, shrubs, and trees in the Coastal Plain furnish some browse, although none are exceptionally good. However, these supply feed mainly in winter and early spring when herbaceous forage is scarce. Vines commonly browsed are honeysuckles (Lonicera spp.) and smilax, chiefly during the winter. Among shrubs taken to some extent are waxmyrtles, groundsel tree (Baccharis halimifolia), sumach (Rhus Copallinum), and holly (Ilex spp.) during the winter, and some of the huckleberries during the spring. Of the trees, bays are browsed some during the winter and the gums (Liquidambar styraciflua and Nyssa sylvatica) and sourwood (Oxydendrum arboreum) during early spring.

Not a great deal is known about poisonous plants in this area. Yellow jessamine (Gelsemium sempervirens) and wicky (Kalmia sp.) are generally regarded as poisonous, and it is likely that these and others cause more death losses than the farmers realize. Studies are definitely needed to determine what poisonous plants are present in the Coastal Plain, when and in what abundance they cause trouble, and what can be done to control them.

Status of Beef Cattle Industry

Interest in raising beef cattle in the Coastal Plain of North Carolina has increased markedly in recent years as indicated by the increase in number of herds, number of cattle, and improvement in beef type. From 1938 to 1940, for example, the number of herds and cattle nearly doubled, and the number of purebred bulls more than trebled. In view of this rapid expansion, the forestry grazing studies should be of considerable value in helping guide the beef cattle program of many farmers. The chief factors contributing to the increased interest are:

1. Reduction in cash crop acreages.

2. Increased farm diversification and the realization that an added source of income can be derived from beef cattle by utilizing native forage, and roughage that may otherwise go to waste.

3. More emphasis placed on soil conservation.

4. The need of manure in maintaining soil fertility on the farm.

5. Increase in amount and quality of tame permanent pastures.

6. Increase in production of feed crops.

7. Farm labor difficulties.

8. Relative prices received for beef cattle, feed crops, and cash crops.

9. Increased local demand for beef cattle and beef cattle products and improvement in local marketing facilities.

10. Increase in 4-H Clubs and other extension work.

11. Use of trench silos.

Hereford breeding by far predominates in the Coastal Plain, although all of the more common breeds are represented. The quality of cattle varies from native to purebreds, but the farmers seem to realize the value of good animals and are trying to get those best suited to their conditions. The herds vary in size from a few animals up to about 1,000 head.

An average example of year-round management is approximately as follows:

April 15 to November 15:	Ranging in forests and on tame permanent pastures.
November 15 to January 15:	Gleaning corn stalks and soybean or velvet bean fields.
January 15 to April 15:	Grazing on one or more of the following: rye, oats, barley, wheat, crimson clover, Italian rye grass, vetch.
November 15 to April 15:	Gleanings and grazing supplemented when necessary with some of the following feeds: peanut straw, soybean hay, lespedeza hay, corn stover, grass hay, silage, cottonseed hulls, corn, cottonseed meal, and soybean meal.

Systems of management vary from ranging cattle on forest areas throughout the year to keeping them entirely on tame permanent pastures and cultivated crops. Based on the survey, forest ranges account for 29 percent of the year-long sustenance of the animals, tame permanent pastures, 29 percent; maintenance feeds, 18 percent; corn stalks, etc., 11 percent; and small grains, fattening feeds, and summer annuals the remainder. Usually all of these different sources of feed fit well into a year-long program of management. In a few cases farmers have cattle primarily because they have an abundance of wild native forage, but even these generally rely on other sources of feeds for certain seasons of the year.

Twenty-eight percent of the stockmen finish out some steers, either of their own raising or additional ones purchased. An increasing number of breeders are marketing their cattle chiefly as weaned calves, feeling that it is more profitable to keep larger cow herds and thus sell more calves. This being the case, many beef producers are interested in how to produce the most profitable weaned calves and desire information on the value of supplemental feeding.

Less than half of the farmers give their cattle mineral supplements other than salt. Most of those using phosphorus and calcium supplements state that they obtain marked improvements through their use, as indicated by more thrifty condition. Some think that other mineral deficiencies exist in certain localities and a few are now adding iron, copper, and cobalt to the mineral mixtures. Exploratory studies made on this project indicate that supplements of certain of these minerals improve both the percentage calf crop and the general condition of the animals. Without the supplements, blood analyses showed the hemoglobin content to be low during some seasons of the year. More information and research is needed on the extent and severity of mineral deficiencies and on methods of correcting them. (In the studies here outlined all groups of cattle will have free access to a mineral mixture composed of calcium, phosphorus, salt, iron, copper, and cobalt.)

Tame Permanent Pastures

Tame permanent pastures are an important source of grazing in the Coastal Plain as evidenced by their furnishing 29 percent of the year-long sustenance of the animals. The extent of their use is also increasing. This is brought out by the fact that approximately 56 percent of them have been seeded since 1937 and there is a considerably larger acreage of planned seeding. In fact, many forest ranges will be used to a greater extent for early spring and winter grazing when tame permanent pastures are developed for summer use. At present, lespedeza is the most extensively used pasture plant, furnishing grazing from about the first of June to the first of November. Other important pasture plants are carpet grass, bermuda grass, red top, Dallis grass, blue grass, and white clover. A few open forest areas have been planted to tame pasture grasses.

LITERATURE COVERING EXPERIMENTAL WORK ON FOREST GRAZING

IN THE SOUTHEASTERN UNITED STATES

Studies of grazing and beef cattle production in the reed forage type have been carried on at the Blackland Test Farm in eastern North Carolina for the past 12 years by state agencies, and state and federal agencies cooperating. Some of the results are reported in publications by Foster, Hostetler, and Case (7) and Hostetler, Foster, and Hankins (8). These studies had to do with beef cattle production in general in the reed forage type, and with the production and quality of meat of native yearling cattle compared with grade yearlings. Reeds were used for about 8 months each year, from about the first of May to the first of January, and represented only 9 percent of the total cost of keeping a cow through the year. The calves were dropped in February, March, and April, and were also on reed pastures until weaned about November 15. At this time they usually weighed between 350 and 400 pounds. The winter feed cost represented an average of 85 percent of the total cost of weaned calves.

The calves and yearlings usually made satisfactory gains on the native forage from the time they were turned on the pastures until about the first of August when the rate of gains for the remainder of the season dropped to less than half. The pastures were stocked at an average rate of about 2 acres per animal unit for each season. However, an unpublished analysis made recently of the rate of stocking of the pastures for the past 11 years indicates that this rate of stocking (average of 2.1 acres per animal for 11-year period) was too high for sustained yield. At the end of 11 years many of the reeds were killed by heavy grazing and some of the pastures had decreased to about half in grazing capacity. General observations showed that most of the decrease occurred in the past few years when the weather was drier than usual.

The experiments comparing the cost of producing grade versus native cattle showed that the gains of the former were about $1.31 per cwt cheaper. When the cattle were on reed pastures during the summer the calves from the grade animals gained 0.14 pounds more per head daily than those from the native cattle and weighed 53 pounds more when weaned in November.

The results of a forest grazing survey in the Coastal Plain of Georgia are reported by Biswell, Southwell, Stevenson, and Shepherd (4). They state that forest lands in this area contribute a large percentage of the year-long sustenance of beef cattle. However, the calf crops are very low, ranging from about 40 percent up to 70 percent, and many farmers are not getting as good returns from their cow herds as they should. There are several problems in forest range grazing and beef

cattle management in this area on which more information is needed, the chief of which are: (1) development of practices that will result in more profitable use of the forest range each year and thereby reduce the wintering costs; (2) development of improved practices in controlled burning to improve the forage for grazing; (3) determination of the grazing capacity of different types of forest range for sustained yield, and the effect of different intensities of grazing on tree reproduction and growth and on cattle gains; and (4) the kinds and extent of any mineral deficiencies and means, costs, and values of correcting them.

Wahlenberg, Greene, and Reed (9), working in Mississippi, report the effect of four land treatments -- burned pasture, unburned pasture, burned ungrazed, and unburned ungrazed -- on the use of longleaf pine land for cattle grazing as well as for timber production. They found that annual winter burning of uncontrolled intensity retarded the growth of longleaf pine sapling trees by about one-fifth in diameter and one-fourth in height during a 5-year period. The survival of seedlings after 10 years following a good seed crop, was 43 percent on the unburned, ungrazed area as against not over 5 percent for any one of the other three land treatments. However, because of the brown spot needle disease, none of the treatments were successful in bringing new longleaf pine seedlings out of the grass stage. During this time both the growth and cone production of older trees apparently was little affected.

Annual winter burning of uncontrolled intensity in the "wiregrass" type maintained more favorable composition, quality, and quantity of forage than did exclusion of fires. This was reflected in the greater seasonal gains in weight of cattle on the burned area. The authors concluded that while annual winter fires of uncontrolled intensity improved the forage conditions for cattle, the results indicate that successful regeneration of longleaf pine may depend upon some system of periodic controlled burning rather than the extremes of annual fires of uncontrolled intensity or fire exclusion, both found by this study to be unsatisfactory. Burning and grazing did not result in serious soil degradation. The burned-over soils exhibited slightly favorable chemical characteristics and unfavorable physical characteristics in comparison with unburned soils, although none of these changes appeared to be of any practical significance. The net effect on plant growth of these soil changes was not measured.

Animal nutrition studies by Becker, Neal, and Shealy (1, 2) in Florida show that animals on open range may be in poor condition because of mineral deficiencies in the native forage and that by supplying proper minerals their condition may be improved.

Because Wahlenberg, Greene, and Reed (9) present an excellent review of world literature pertaining to forest grazing and burning in other places up to this time, it is not necessary to present another here.

FOREST RANGE GRAZING PROBLEMS

Many problems and questions about effective forest range grazing need research, as was revealed by: (1) the farmers interviewed on the survey, (2) the experimental work already done in this area, (3) general observations, (4) discussions with persons interested in land-use problems, and (5) the literature on this subject. The chief of these problems are:

1. To determine the sustained grazing capacity of the different types of forest range, the relative values of the important forage plants through all seasons of the year, and the effects of different degrees, seasons, and systems of grazing on the forage and on cattle gains, and on tree reproduction and growth.

2. To determine the value of supplementary feeding of different classes of animals on the forest range at different seasons of the year, and of providing supplemental pastures for late summer grazing.

3. To determine the relative values of different planes of nutrition for wintering various ages of cattle that are run primarily on forest range.

4. To determine the need for mineral supplements of different kinds on forest ranges and the value of correcting any deficiencies.

5. To determine the effect of breeding season and breeding age upon beef production.

6. To determine the kinds of poisonous plants, their distribution, abundance, poisonous properties, effect on beef production, method of control, and economic importance on the forest range.

Obviously a research program can not effectively cover all these at any one time, or perhaps all the different phases of a single problem. Therefore, it is necessary to select the most important forage type, or types, and problems of greatest importance and first tackle those phases it is thought will yield the greatest and quickest returns to the farmer. In selecting these, it is necessary to give consideration to both efficient cattle production and efficient timber production if the most is to be obtained from the land.

Research studies may eventually indicate when and under what condition either of these should be given primary consideration. In fitting these uses together some practices that may be beneficial to one, may to some extent, of course, be detrimental to the other.

SELECTION OF FORAGE TYPE AND LOCATION OF STUDIES

It is thought the studies should begin primarily in the reed forage type for the following reasons:

1. It is one of the largest forage types in the Coastal Plain.
2. It is most extensively used for cattle grazing at present.
3. The possibilities for expanding cattle grazing appear to be greatest in this type.
4. Two state work centers where the experiments can be conducted are already established here.

One of the work centers is at the Hofmann Forest in the southeastern section of the Coastal Plain, and the other is at the Blackland Test Farm in the northeastern section of the Coastal Plain. The forage at the Hofmann Forest is mainly of reeds, although a great combination of herbaceious and browse plants, and different types of forage occur here. Parts of the forest are typical of the wiregrass type. The forest grazing land at the Blackland Test Farm, largely peat soil, was drained and logged several years ago and since then has burned over so frequently that practically no trees survive. The forage is mainly of reeds. However, in spring and early summer, warty panicum (Panicum verrucosum) provides considerable feed. Other species appear to be of minor importance.

PROBLEMS OR PHASES OF PROBLEMS SELECTED FOR STUDY

(Line Project)

The problems or phases of problems selected for study all have to do with finding the most practical systems for utilizing the reed forage type by cattle.

(Subprojects)

Subprojects selected for study at present, are:

1. Rotation grazing on forest range.
2. Creep feeding of calves on forest range.
3. Logging effects and degree of grazing.
4. Effect of two rates of grazing on burned and unburned areas.

5. Different planes of nutrition for wintering breeding cows on forest range.

6. Wintering calves on reeds.

7. Relative grazing values and nutritive properties of forage plants as shown by chemical analyses.

OUTLINE OF FOREST GRAZING PROJECT PROGRAM

This section presents the following information about each of the subprojects selected for study:

Purpose
Importance of study
Methods
    Field procedure and records
    Statistical analysis
Duration

Certain parts of the methods section will be expanded in more detail as the work develops.

Rotation Grazing on Forest Range

(Subproject No. 1)

Purpose:

To compare the practice of continuous grazing of the reed forage type with the practice of rotating one time during the season and with rotating every 28 days (to be done at Blackland Test Farm).

Importance of Study:

Past experiments on beef cattle production in the reed forage type, together with general observations, show that reeds may be easily killed by continuous heavy spring grazing. Further, these studies and observations show that cattle usually make satisfactory gains on this type of forage until about the first of August, but for the remainder of the season the rate of gain usually drops to less than half and is not considered satisfactory. To best use this type of range for sustained forage yield, and for better cattle gains after the first of August, more information is needed on different management practices.

Methods:

Field Procedure and Records.

1. (A). Divide 30 Hereford yearling steers into three uniform groups about May 1 and graze on reed pasture until about November 15 as follows:

Group 1

This group of 10 steers to be subdivided into two uniform groups designated as Groups 1-a and 1-b; each subdivision of 5 steers to be grazed on 15-acre pastures continuously, but the two groups rotated between the pastures every 28 days. These two sub-groups will have similar treatment and may be considered as one group of 10 steers.

Group 2

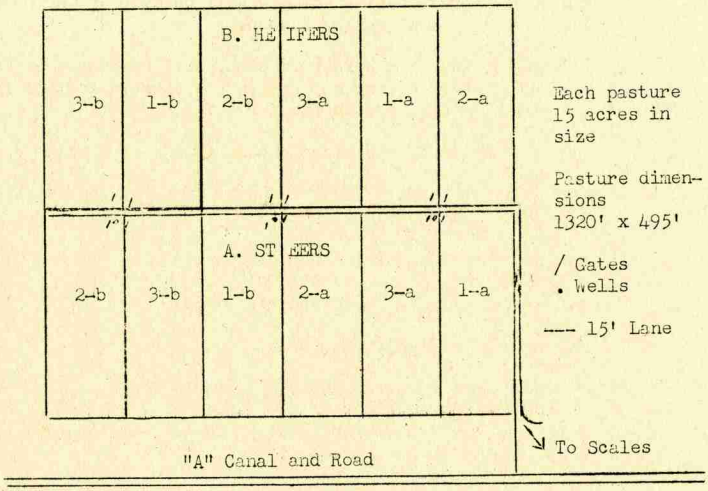
Graze 10 steers on a 15-acre reed pasture from about May 1 to August 1 (end of a weigh period) then transfer them to another of 15 acres until November 15 (end of season).

Group 3

Graze 10 steers on a 15-acre pasture for 28 days, from about May 1, and then transfer to another for 28 days. Continue rotating between the two pastures every 28 days until November 15. These pastures have not been grazed extensively since 1936, and are exceptionally uniform in every respect.

(B) Repeat A, except use heifers instead of steers -- this to serve as a replication of A. Strictly speaking, this is not a replication; but because of finances and the difficulty of getting either 60 steers or 60 heifers, and the need for at least 10 animals for each treatment, it is thought best to use this combination. There is no reason to believe that the sexes would respond differently to the rotation systems, or that they would have different effects on the forage; however, this can be determined from the data. It is expected that the steers, on an average, will make slightly better gains than the heifers, as they usually do in pasture or feeding tests.

2. The pasture layout and the rotation systems are as follows:



Pastures 1 - Grazed continuously with 5 cattle each, but the cattle are shifted every 28 days. (A and B are handled independently of each other.)

Pastures 2 - Ten cattle grazed in 2-a from about May 1 to about August 1, then grazed in 2-b to about November 15.

Pastures 3 - Ten cattle turned in 3-a about May 1 (opening of grazing season) and rotated between 3-a and 3-b every 28 days until about November 15 (end of grazing season).

3. All yearlings will be weighed individually at the beginning and close of each grazing season and at 28-day intervals during the grazing period. The initial and final weights used will be the average of those taken on three consecutive days at the beginning and close of each grazing season. Each yearling will also be graded according to the U. S. Grading System by a committee just before pasturing and after removal. The grade will form the basis for appraised value.

4. Notes on the condition of the cattle will be kept throughout the period as well as complete cost records and financial returns of the different methods of handling the groups. Pictures of representative animals will be made at the beginning and close of each grazing season.

5. Six plots, each 3 x 3 feet in size, will be placed at random in each pasture before any grazing is started and the following measurements made on the forage:

   a. Estimates of total forage density and of species composition.

   b. Height of reeds.

   c. Density of reeds (number of stalks).

   d. Average length and width of leaves.

   e. Leaves weighed (plucked).

   f. Stems cut 6 inches above soil and weighed.

   A plot at the end of each pasture on the outside will be treated in the same way.

   Similar measurements will be made at the end of each grazing season.

6. Observations of cattle grazing and degree of use of the pastures will be made and recorded at the beginning of each 28-day period.

Statistical Analysis.

CATTLE (for one year)		FORAGE (for one year)	
Source of variation	d.f.	Source of variation	d.f.
Type of animal (replications)	1	Replication	1
Grazing system	2	Between pastures	5
Experimental error	2	Experimental error	5
Sampling error (animal var.)	108	Within pastures	60
Total	113	Total	71

Concomitant variates will also be used in the analysis of the results.

Duration:

This subproject should be carried through at least three full seasons. As far as the effects on the forage are concerned, it should be carried on for a period of about 10 years. This study was started in the fall of 1940.

Creep Feeding of Calves on Forest Range

(Subproject No. 2)

Purpose:

To determine the value of creep feeding calves on reed pastures to weaning age, and to compare this with the value of running calves on reed pastures in the early part of the season and then transferring them to lespedeza pasture until weaned (to be done at the Blackland Test Farm).

Importance of Study:

An increasing number of breeders are marketing their cattle chiefly as weaned calves, feeling that it is more profitable to keep larger cow herds and thus sell more calves. This being the case, many beef producers are interested in the production of weaned calves and desire information on the values of supplemental feeding. Supplementary feeding of calves on forest range, through either creep feeding or improved pastures, offers possibilities of economically increasing meat and hide production in this area.

Methods:

Field Procedure and Records.

1. Divide 40 grade Hereford cows and their 40 nursing spring calves (at the Blackland Test Farm the cows are usually bred between May 1 and August 1. Heifers are bred to drop their first calves at three years of age.) into four uniform groups about May 1 and graze until November 15 as follows:

   Group 1

   Graze 10 cows and their 10 calves on reed pasture without any supplements -- this group to serve as a check.

   Group 2

   Graze 10 cows and their 10 calves on reed pasture and creep feed the calves throughout the period on a concentrate mixture of 4 parts shelled corn and one part cottonseed meal.

Group 3

Graze 10 cows and their 10 calves on reed pasture and creep feed the calves after August 1 on a concentrate mixture of 4 parts shelled corn and one part cottonseed meal.

Group 4

Graze 10 cows and their 10 calves on reed pasture until about July 1 (at the end of a weigh period) and then transfer them to lespedeza pasture.

Four reed pastures of 40 acres each will be used in this experiment and it is thought this acreage will provide abundant grazing for the summer period. The pastures will join those used in the rotation grazing experiment. This area has not been used extensively for grazing since 1936 and is very uniform in character. The four groups of cattle will be shifted between the pastures every 28 days in order to lessen the effect of any pasture differences. The pasture layout and shifting arrangement will be as shown in the diagram on the following page.

2. All cattle will be weighed individually at the beginning and close of each grazing season and at 28-day intervals during a grazing period. The initial and final weights used will be the average of those taken on three consecutive days at the start and close of each trial. Each animal will also be graded according to the U. S. Grading System by a committee about May 1 and November 15. The grade will form the basis for appraised value.

3. Daily feed records as well as complete cost records and financial returns of the different methods of handling the groups will be kept throughout the period. Pictures of representative animals will be made at the beginning of each season and of groups at the close of each season.

4. Every 28 days the pastures will be observed to find if any differences are showing in degree of utilization and if plenty of feed is available. Notes will be prepared each time.

Statistical Analysis.

CATTLE (for one year)

Source of variation	d.f.
Between groups	3
Within groups	36
Total	39

1st 28 days	(1941)	2	3	1	4
	(1942)	3	1	4	2
	(1943)	1	4	2	3
	(1944)	4	2	3	1
2nd 28 days	(1941)	3	4	2	1
	(1942)	4	2	1	3
	(1943)	2	1	3	4
	(1944)	1	3	4	2
3rd 28 days	(1941)		2	1	3
	(1942)		1	3	2
	(1943)		3	2	1
	(1944)		2	1	3
4th 28 days	(1941)		1	3	2
	(1942)		3	2	1
	(1943)		2	1	3
	(1944)		1	3	2
5th 28 days	(1941)		3	2	1
	(1942)		2	1	3
	(1943)		1	3	2
	(1944)		3	2	1
6th 28 days	(1941)		1	3	2
	(1942)		3	2	1
	(1943)		2	1	3
	(1944)		1	3	2
	(etc.)	D	C	B	A

"A" Canal and Road

Each pasture 40 acres in size.

Pasture dimensions 3485' x 500'

/ Gates

. Wells

A, B, C, D Pastures

1, 2, 3, 4 Cattle groups

Scales and Corrals

Duration:

This experiment should be continued through at least four full seasons. This study was started in the fall of 1940.

Logging Effects and Degree of Grazing

(Subproject No. 3)

Purpose:

To find the effect of cattle grazing on tree reproduction following logging, and the effect of logging and degree of use on grazing capacity (to be done at the Hofmann Forest).

Importance of Study:

There is considerable question among foresters and cattle producers as to whether grazing in this forage type is beneficial or detrimental to tree reproduction. On this hinges largely the practicability and economics of the multiple use of forest lands for timber growing and cattle raising. Some land managers claim that cattle grazing in this forage and forest type will destroy seedlings and young trees while others maintain that it keeps down some of the undergrowth and by doing this, tree reproduction is favored. More information is definitely needed on this question before forest grazing in this type can be fully and properly evaluated.

In order to make proper adjustments in cattle numbers following logging operations it is desirable to determine how the grazing capacity and rate of animal gain is affected.

Methods:

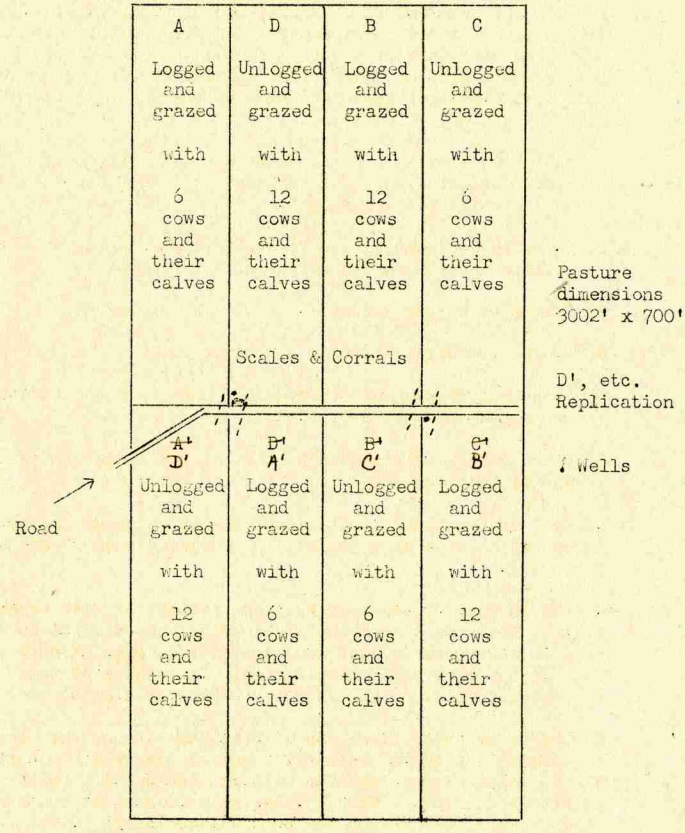
Field Procedure and Records.

1. Fence 8 pastures of 48 acres each and treat as indicated in the figure. The lower set of pastures in the figure is a replication of the upper set of pastures.

2. Divide 72 cows and their calves into uniform groups (numbers indicated in figure) about May 1 and graze them on the pastures until about November 15. When the animals come off this experiment each year they will be placed together in a pasture until started on subproject No. 5. (Different planes of nutrition for wintering breeding cows on forest range.)

3. At the beginning and close of each grazing season, the animals will be graded according to the U. S. Grading System by a committee. The cows will also be graded according to condition and vigor, and the calves will be appraised. All cattle will be weighed individually at the beginning and close of a test and at 28-day intervals during a grazing period. The initial and final weights used will be the average of those taken on three

consecutive days at the beginning and close of a grazing season. The cows will go back into the same pastures each season.



4. Group pictures of the cattle will be made for each of the four pasture treatments at the beginning and close of a grazing season.

5. One square plot, 1/4 acre in area, will be placed at random in each one-fourth section of a pasture and staked. Another plot

will be paired with each of these and fenced, making a total of 4 unfenced and 4 fenced plots in each pasture. The unfenced plots will be at least 1 chain from those fenced.

6. In each unfenced and fenced area, two plots 6.6 x 6.6 feet in size will be placed at random (border strip within each unfenced or fenced enclosure of about 10 feet), on which the following measurements will be made: (The initial measurements should be made in the fall at about the time of the close of the normal grazing season.)

   a. All tree seedlings to be counted and height measured; if above breast high, diameter at this level instead of height will be measured.

   b. Density and composition of other plants on the plots will be estimated and height measurements taken.

   c. Vigor to be estimated.

   d. Degree of utilization to be estimated.

   e. Any tree grazing or other damage done by the cattle to be noted and recorded.

   Similar measurements should be made at the close of each grazing season if time permits.

7. General observations of utilization, and stage of growth of the important species will be made and recorded each 28-day weigh period.

8. Cattle in four of the pastures, one pasture of each treatment, will be followed near each weigh period (the time to be divided between the pastures) and composite forage samples representative of the diet will be collected. Composites of these samples, by pastures, will be made for the entire grazing season.

   Observations and collections will be made in one set of pastures one period and in the replicated set of pastures the next time. The composite forage samples will be made up of portions of the plants grazed at the time. These will be sent to the laboratory at the end of the season for chemical analysis. During each observation period, notes will be taken of the following:

   a. Approximate percentage of each species in the diet.

   b. Portions of plants taken.

c. Grazing habits.

1. Time of day.
2. Type of areas grazed.

d. General notes of any other differences between pastures or groups.

9. A permanent photo-station will be established on each of the fence lines separating the pastures and pictures made before starting any grazing and at the close of each grazing season. Another will be established on the boundary of one of the fenced enclosures in each of the pastures. A picture will be made here also before any grazing is started, and at the end of each grazing season.

Statistical Analysis.

CATTLE (for one year)

Source of variation	d.f.
Replication	1
Logging	1)
Intensity	1)
L x I	1)
Rep. x Main effects	3
Animals in groups	64
Total	71

FORAGE (for one year)

Source of variation	d.f.
Replication	1
Logging	1)
Intensity	1)
L x I	1)
Error (a)	3
Location in plot	24
Treat (grazing)	1)
T x L	1)
T x I	1)
T x L x I	1)
Error (b)	4
Treat x Location in plot	24
Sampling error	64
Total	127

For such variables as amount of forage removed by grazing, which is measured by the difference between the fenced and unfenced plots, only the first half of the forage analysis is applicable.

Duration:

This experiment should be continued for a period of at least 10 years. This study was started in the fall of 1941.

Effect of Two Rates of Grazing on Burned and Unburned Areas
(Subproject No. 4)

Purpose:

To find the effect on reeds of two rates of grazing on both burned and unburned areas (to be done at Blackland Test Farm).

Importance of Study:

Reeds die out very readily if too heavily grazed, especially in areas that have been burned over. For this reason it is especially important to know the degrees of use that result in a decrease in the grazing capacity under different conditions and to develop measures that can be used in predicting the effects of different degrees of use.

Methods:

Field Procedure and Records.

1. Twelve enclosures of about 1 acre each to be fenced and treated as indicated in the figure below. The treatments in each half of the burned and unburned areas to be assigned at random.

BURNED	UNBURNED
Graze moderately	Protect
Protect	Graze heavily
Graze heavily	Graze moderately
Protect	Protect
Graze heavily	Graze moderately
Graze moderately	Graze heavily

Plot size 300' x 150'

. = Wells

2. Starting at the beginning of the grazing season, two animals to be kept on each of the heavily grazed plots while there is one on each of the moderately grazed plots. If the animals in the heavily grazed plots do not maintain their weight, owing to lack of feed, all of the animals may have to be removed from the plots for a short time to allow for some forage regrowth. The main object is to keep certain plots grazed heavily while others are grazed moderately.

3. Records will be kept of the number of cow-days grazing from each plot. Although there are not enough animals in each area for cattle gains or losses to mean very much, they will be weighed each time they are put on or taken off the plots.

4. Two plots, each 3 x 3 feet in size, will be placed at random in each of the enclosures and the following measurements made on the vegetation:

   a. Estimates of total plant density.

   b. Estimates of forage composition.

   c. Heights of important species.

   d. Reed stalks counted.

   e. Length and width of reed blades measured.

   f. Vigor of reeds estimated.

   Similar measurements will be made at the end of each grazing season.

5. At the end of 5 years all plots will be protected for a full season (or small enclosures established) and measurements made of forage yield under each condition.

6. Two permanent photo-stations will be established for each of the grazing conditions. Pictures will be taken at the start of the experiment and at the close of each grazing season. Pictures may be taken more often if desired to show degree of utilization at different times through a season.

Statistical Analysis.

FORAGE (for one year)

Source of variation	d.f.
Replication	1
Burning	1
Error (a)	1
Grazing	2
Grazing x Burning	2
Error (b)	4
Total	11

FORAGE (for five years)

Source of variation	d.f.
Replication	1
Burning	1
Error (a)	1
Grazing	2
Grazing x Burning	2
Error (b)	4
Years	4
Grazing x Years	8
Burning x Years	4
Grazing x Burning x Years	8
Error (c)	24
Total	59

Duration:

This experiment should be continued through at least five full grazing seasons. This project was started in the fall of 1940.

Different Planes of Nutrition for Wintering Breeding Cows on Forest Range (Subproject No. 5)

Purpose:

To study the relative value of different planes of nutrition for wintering breeding cows on forest land, and the effect of winter grazing on the forage and tree reproduction (to be done at the Hofmann Forest).

Importance of Study:

Forest lands, especially those containing thick and protected stands of reeds, furnish much winter feed. Also, burned wiregrass ranges may furnish early spring grazing. Some cattlemen rely on the forest range entirely for wintering their cows, while others supplement this with varying amounts of harvested feeds. Where no supplements are fed, the calf crops are very low and usually death losses are high, but the most profitable plane of nutrition to winter the cows needs investigating. Work will also be needed later to determine this for different ages and classes of cattle as well as for cows. To fully evaluate forest grazing, studies are needed to determine the effect of winter grazing on the forage and on the trees, and to find how the grazing capacity for this season of year compares with that during the summer.

Methods:

Field Procedure and Records.

1. The 72 cows used in subproject No. 3 (Logging Effects and Degree of Grazing) to be divided into three uniform groups about January 15 (earlier if the animals begin to lose weight) and winter as follows:

Group 1

Twenty-four animals to be grazed on reed pasture and supplemented with 2 pounds of cottonseed meal per head daily.

Group 2

Twenty-four animals to be grazed on reed pasture and supplemented with 4 pounds of cottonseed meal per head daily.

Group 3

Twenty-four animals to be grazed on reed pasture and supplemented with 6 pounds of cottonseed meal per head daily.

Three reed pastures of approximately 125 acres each will be used in this experiment and it is thought this acreage will provide abundant grazing for this period (six cows will come out of each group about March 15 as explained later). The three groups of cattle will be shifted between the pastures every 28 days to lessen any pasture differences. The pasture layout and shifting arrangements will be as follows:

DIAGRAM

	A	B	C
1st 28 days	2	3	1
2nd 28 days	1	2	3
3rd 28 days	3	1	2
4th 28 days	2	3	1
5th 28 days	1	2	3

A, B, C. - Pastures
1, 2, 3. - Cattle groups

2. About March 15 (end of a weigh period) six cows will be taken from each of the three groups and placed on wiregrass type range prescribed-burned in late December, and protected against any grazing up until March 15. Between 4 and 5 acres of burned range will be provided for each cow. This group of cows will receive no supplements in addition to the burned range. The prescribed burning will be rotated over the range and different portions burned every other year.

3. All cattle will be weighed individually at the beginning and close of each test and at 28-day intervals during a grazing period. The initial and final weights used will be, where practical to weigh three times, the average of weights taken on three consecutive days at the beginning and close of a test. Each animal will also be graded according to the U. S. Grading System by a committee at the start and close of a test. At the close of a trial, the cows will be graded according to condition and vigor and the calves will be appraised.

4. Daily feed records of the cattle will be kept throughout the period as well as complete cost records and financial returns of the different methods of handling the groups. Records kept for experiment No. 3 (Logging Effects and Degree of Grazing) will show the effect of condition of wintering on summer gains.

5. Pictures of representative animals in each group will be taken at the start and close of each test.

6. Four square plots, each 1/4 acre in area, will be placed at random in each of the three reed pastures and staked. Four other plots, of a similar size, will be paired with these and fenced. In the prescribed-burned wiregrass pasture two of each of these, largely for observational purposes, will be established -- more later if needed. In each unfenced and fenced area, two plots 6.6 x 6.6 feet in size will be placed at random and the following measurements made:

   a. All tree seedlings will be enumerated and height measured; if above breast high, the diameter at this level will be measured.

   b. Composition and density of other vegetation on the plots will be estimated and height measurements taken.

   c. Stage of development of the important species will be recorded.

   d. Vigor to be estimated.

   e. Degree of utilization at close of season to be estimated.

Similar measurements will be made at the close of each grazing season.

7. Observations will be made of the pastures every 28 days to note any differences in utilization, feed available, and to record the stage of development of the important species.

8. Some cattle of each group will be followed near each weigh period and composite forage samples representative of their diet collected. Samples by groups for each entire test period to be composited. The composite forage samples will comprise portions of the plants grazed at the time. At the end of the grazing period these will be sent to the laboratory for chemical analysis. Notes of the following will be taken during each observation period:

   a. Approximate percentage of each species in the diet.

   b. Portions of plants taken.

   c. Grazing habits.

      1. Time of day grazing is done.
      2. Type of areas grazed.

   d. General notes of any other differences between pastures or groups.

9. Two permanent photo-stations will be established in each pasture on the boundary fence of two of the enclosures. Pictures will be taken at the beginning and end of each yearly test.

Statistical Analysis.

CATTLE (for one year)
(until division made about Mar. 15)

Source of variation	d.f.
Between groups	2
Cows in groups	69
Total	71

CATTLE
(after division made about Mar. 15)

Between groups	3
Cows in groups	68
Total	71

FORAGE (for one year)
(for reed pastures)

Source of variation	d.f.
Pastures	2
Treatment (grazed-not grazed)	1
P x T	2
Locations in pastures	9
Experimental error	9
Sampling error	24
Total	47

Duration:

Except for minor variations in supplemental feeding, this experiment should be continued for a period of at least 10 years. This study was stated in the winter of 1941-42.

Wintering Calves on Reeds
(Subproject No. 6)

Purpose:

To compare wintering weaned calves in reed pastures to wintering on the farm.

Importance of Study:

Wintering of cattle on the farm is the most expensive period of any season of the year. Where reed forage is available, it is possible that through supplemental feeding in the forest, the cost of wintering can be greatly reduced. The practicability of wintering on reeds needs testing.

Methods:

Field Procedure and Records.

1. Calves from subproject No. 2 (Creep Feeding of Calves on Forest Range) will be divided into four equal groups at weaning time. The basis for division also includes individuals from each of the four groups.

   Groups 1 and 2

   These calves to be wintered much as in former years on the Blackland Test Farm, namely; corn stalk and soybean field gleanings and winter pasture supplemented with corn stover and soybean hay when sufficient forage is not available. In addition, approximately 2 pounds of concentrates are fed per head daily. When winter pasture is available, Group 1 will be grazed on Abruzzi Rye and Group 2 on Italian Rye grass. Therefore, the only difference in the treatment of Groups 1 and 2 will be in the kind of winter pasture. These winter pastures will be approximately 10 acres each and will be seeded early. When tests by the Agronomy Department of North Carolina State College indicate that other pasture crops may be better suited for winter grazing, they may be substituted for the ones used in this test.

Groups 3 and 4

These calves will be grazed on reeds; Group 3 supplemented with 2 pounds of cottonseed meal per head daily and Group 4 with 4 pounds. Abundant reed forage will be provided in pastures already fenced, but the groups will be alternated between these two pastures every weigh day to lessen the effect of any pasture differences.

2. All cattle will be weighed individually at the beginning and close of each test and at 28-day intervals during the grazing period. The initial and final weights used will be, where practical, the average of weights taken on three consecutive days at the beginning and close of each test. Each animal will also be graded according to the U. S. Grading System by a committee at the start and close of each test.

3. Daily feed records of the cattle will be kept throughout the period as well as complete cost records and financial returns of the different methods of handling the groups.

4. Group pictures of the cattle will be made at the beginning and closing of each wintering period.

5. At the end of every 28-day period, the reed pastures will be observed and a record made of the degree and uniformity of utilization and condition of the forage. The cattle will also be observed each time to find the forage species grazed and the portions of plants consumed.

6. The Agronomy Department of North Carolina State College plans to make growth measurement and yield studies of the annual winter pastures.

Statistical Analysis.

CATTLE (for one year)

Source of variation	d.f.
Between groups (Reeds vs. Farm Gleanings 1)	3
Animals in groups	36
Total	39

(At the close of this test, the animals will be used in subproject No. 1, Rotation Grazing on Forest Range).

Duration:

This experiment should be continued through at least 3 full seasons. The pastures were burned over in the fall of 1941 which delayed one year the starting of the study.

Relative Grazing Values and Nutritive Properties of Forage

(Subproject No. 7)

Purpose:

To study utilization, palatability, and value of forage plants for grazing (to be done at the Blackland Test Farm and the Hofmann Forest).

Importance of Study:

To manage properly any grazing area, it is necessary to know the plants that furnish the bulk of the feed at different seasons of the year, and something of their palatability and nutritive values. This type of data is necessary for determining such things as grazing capacity, season of most profitable use, and kinds and amounts of supplements needed.

Methods:

Field Procedure and Records.

1. Each two weeks some of the cows on pasture at the Blackland Test Farm and at the Hofmann Forest will be followed and forage samples representative of their diet collected. These will be sent to the laboratory for chemical analysis. Notes will be taken of the following:

   a. Percentage of each species in the diet.

   b. Portions of plants grazed.

   c. Grazing habits.

      1. Time of day grazing is done.
      2. Type of areas grazed.

   d. Approximate composition of the plants making up the vegetation cover in the areas grazed.

2. Pure samples of two or three of the most important species will also be collected each two weeks for chemical analysis. These collections will be made throughout the year when animals are grazed on forest range.

Statistical Analysis.

These data will not be suited to any statistical treatment.

Duration:

These collections and analyses should be continued for a period of at least 3 years. These studies were started in the fall of 1940.

PREPARATION OF REPORTS

Brief progress reports covering each subproject will be prepared annually. About every 3 years bulletins will be published covering the work completed up to that time. These bulletins may be of individual subprojects or may cover two or more subprojects combined. For subprojects of longer duration publications in the form of progress reports will also be prepared about every 3 years.

Subprojects that should yield enough worthwhile information to justify publications at the end of three complete trials are as follows:

(Subproject No.)

1. Rotation grazing on forest range.
2. Creep feeding of calves on forest range.
4. Effect of two rates of grazing on burned and unburned areas.
5. Different planes of nutrition for wintering breeding cows on forest range.
6. Wintering calves on reeds.
7. Grazing observations and chemical analyses of forage.

Subproject No. 3, Logging Effects and Degree of Grazing, will require at least 10 years for completion. However, it should yield valuable indications, worth publishing in part, before that time.

Technical or popular articles may be prepared covering certain phases of this work whenever it is deemed desirable.

All compilations and publications of these data will be performed jointly by representatives of the cooperating agencies.

RESPONSIBILITY

H. H. Biswell will be directly responsible for the technical supervision of the forestry and forage phases, and J. E. Foster for the animal husbandry phases. The forestry and animal husbandry technicians will have immediate direction of field work. All major changes in the program and the proposal of reports for publication, and the reports themselves will be considered and approved by the directors and heads of the divisions of the various cooperating agencies.

STUDIES OF HIGH PRIORITY TO BE UNDERTAKEN LATER

As the subprojects already outlined are completed, others will be outlined and work started. Some of the problems of high priority on which work is needed are as follows:

1. To determine the practicability of finishing yearling steers completely or partially on reed pastures by the addition of a protein concentrate after August 1, rather than finishing entirely in the dry lot.

2. To study the kinds and extent of mineral deficiencies and the value of correcting them. Some exploratory studies are in progress at present, as mentioned in the section on mineral deficiencies.

3. To study the poisonous plants, their distribution, abundance, effects on beef production, methods of control, poisonous properties, and the most practical solution to this problem.

4. To study proper breeding season and breeding age for cattle run on forest range.

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THE RÔLE OF FOREST GRAZING IN BEEF CATTLE PRODUCTION IN THE SOUTHEASTERN UNITED STATES

PROJECT ANALYSIS AND WORKING PLANS FOR STUDIES IN THE COASTAL PLAIN OF GEORGIA

By

H. H. Biswell and B. L. Southwell

Revised September 1942

A cooperative project of the
Georgia Coastal Plain Experiment Station
Tifton, Georgia

and

The Forest Service and Bureaus of Animal
Industry and Plant Industry of the United States
Department of Agriculture and
The Georgia Experiment Station

FOREWORD

General aims of this project analysis and working plan are as follows:

1. To provide a thorough understanding of the problems of forest grazing in this area and their importance and scope.

2. To insure a thoroughgoing attack on the problems.

3. To guide the execution of the work and insure that pertinent data are collected regardless of change in personnel or change in viewpoint of existing personnel.

4. To inform station directors, chiefs and heads of divisions of methods of attack and progress of the work.

5. To serve as a basis for the preparation of reports and publications.

It is intended that the working plans be rigid enough to insure that the original intent is attained, yet general and flexible enough to permit necessary revision and the investigation of "sidelight" problems. As the work progresses and more information is obtained it will be necessary to make certain changes in technique, but no changes should be made before seeing whether such changes can be incorporated successfully without endangering the primary objectives of the studies. Minor changes may be approved by the project leaders who are responsible for the technical phases of the studies, but any necessary major changes should be approved also by station directors, chiefs and heads of divisions of the various cooperating agencies. All changes should be in the form of written supplements.

The subprojects herein outlined have been reviewed by representatives of all cooperating agencies and general approval obtained.

As certain of these subprojects are completed working plans will be developed for others.

CONTENTS

THE RÔLE OF FOREST GRAZING IN BEEF CATTLE PRODUCTION IN THE SOUTHEASTERN UNITED STATES

PROJECT ANALYSIS AND WORKING PLANS FOR STUDIES IN THE COASTAL PLAIN OF GEORGIA [1/]

H. H. Biswell and B. L. Southwell [2/]

INTRODUCTION

Forest lands comprise nearly two-thirds of the southeastern Coastal Plain region of the United States. Millions of these acres are open forest range that produce forage suitable for livestock production. Since early settlement days relatively large numbers of cattle have grazed here, but only recently much interest was given to developing improved grazing practices on cut-over areas, especially in relation to other types of grazing and timber production. The main reasons for the increased interest are: 1. the eradication of the cattle-fever tick, except for a small area in Florida, 2. greater emphasis on soil conservation, with more winter feed crops and tame pastures to complement forest grazing, 3. scarcity or high cost of farm labor, 4. higher beef prices, and 5. a greater interest in diversified agriculture.

Studies to develop and test improved methods of integrating cattle grazing and timber production were started in 1940 in the Coastal Plain of both Georgia and North Carolina by cooperating State and Federal Agencies. The analysis and working plans presented here are for the experiments in Georgia and are based largely on present conditions and practices in this area. The studies are planned primarily to find how cattle raising and timber production can be most satisfactorily fitted together; with yearlong cattle management practices taken into consideration. In more general terms, the aim is to find how more money can be derived from cut-over lands by combining cattle raising and timber production, and not to compare cattle raising on forest lands with timber production alone. To arrive at this major objective, the fields of animal husbandry, range management, forestry, soils, agronomy, economics, and perhaps others should be drawn upon.

1/ Investigations conducted by the Georgia Coastal Plain Experiment Station, Tifton, Georgia, in cooperation with the United States Department of Agriculture through the Forest Service and Bureaus of Animal and Plant Industry, and the Georgia Experiment Station.

2/ H. H. Biswell, Appalachian Forest Experiment Station, Forest Service, U. S. Department of Agriculture; B. L. Southwell, Georgia Coastal Plain Experiment Station and Bureau of Animal Industry, U. S. Department of Agriculture.

The studies have special importance at this time because they deal with vital necessities for the war -- meat and hides and timber. To meet the demands of the large number of army camps in this area most cattle products are shipped in, and many forest areas are being heavily cut. The studies will have importance during the post-war period also because of the larger acreage of cut-over lands to be managed.

It is recognized that forest lands in this area are generally well adapted to growing timber and in many places perhaps this should be the primary, or sole, objective. On the other hand, trees are relatively slow growing and farmers often have to wait several years to derive any income from their forest lands; yet, they have to pay taxes on them yearly. By combining grazing and timber production, it is possible to have an annual income. To a very large degree the success of such a program depends on foresters willing to make the modifications of practice necessary to aid cattle, and on cattlemen interested in producing high grade timber stands as well as livestock. A sympathetic understanding of both viewpoints is desirable.

SCOPE OF FOREST RANGE GRAZING STUDIES

The principal southeastern Coastal Plain forest ranges are in the 55 million acres of longleaf-slash pine forests extending mainly through North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi (10). Other extensive forest ranges are in the shortleaf-loblolly pine-hardwood forest type of the upper Coastal Plain. This type extends over most of the Piedmont region, covering approximately 80 million acres. It is usually more dense than the longleaf-slash pine type and has less forage. Also, it is in a section where the topography is rolling and the soil fairly erodible; therefore, the question arises as to whether or not the forage should be removed through grazing or left to protect the soil. In many places it is or can be grazed to advantage, no doubt, and by having some of the materials removed from the ground, the fire hazard and losses from devastating fires are reduced.

The forest grazing and beef cattle experiments in Georgia are in a representative section of the longleaf-slash pine forest type, and because the results will apply to some extent to all of this vast forest area, obviously they are of considerable importance. In addition, the studies apply to large acreages of farm lands used in the production of feed crops and tame pastures. They have further importance economically and socially, for, besides affecting the land owners or operators, they affect directly or indirectly all people in the section who depend largely on the prosperity of the farmers for their livelihood. A large percentage of the longleaf-slash pine forest type is already used for cattle grazing, and there is no reason why still greater advantageous use cannot be made through economical management practices. It is estimated that the production of beef cattle on forest lands could be about doubled through better range and cattle management practices, and improving the quality and increasing the number of animals.

CONDITIONS AND PRACTICES IN FOREST RANGE MANAGEMENT

IN THE COASTAL PLAIN OF GEORGIA

The statements in this section of the report are based largely on a survey of forest grazing in the Coastal Plain of Georgia made, in the spring of 1941, primarily to find specifically about present methods and results of managing beef cattle herds and forest grazing lands, and to discuss with farmers their experiences and chief problems in raising cattle and growing trees on the same land (4). It is judged that conditions and practices here are fairly representative of other sections of the 55 million acres of longleaf-slash pine forests of the southeastern United States. A total of 106 operators using forest lands for cattle grazing were interviewed.

General Description of the Coastal Plain of Georgia

On the basis of soils, forest types, and topography, the Coastal Plain of Georgia can be subdivided into the upper Coastal Plain, the middle Coastal Plain, and the lower Coastal Plain. The upper division is more or less typical of the shortleaf-loblolly pine-hardwood type, and the middle and lower divisions of the longleaf-slash pine forests. Approximately three-fourths of the forest land in the entire Coastal Plain region is of second growth timber, 15 percent is old growth timber, and 10 percent is clear cut. The chief shrubs in the upper Coastal Plain division are blackberry briars, hawthornes, and myrtle; in the middle division they are gallberries, blackberry briars, runner oak, and huckleberries; and in the lower division, palmetto, gallberry, huckleberries, runner oak and myrtle. The main native forage species in the forests in the upper division are beardgrasses, panicgrasses and dropseeds; in the middle and lower divisions they are beardgrasses, panicgrasses, and wiregrasses consisting of threeawns, muhly grasses, dropseeds, and similar species. Carpetgrass has become naturalized in many forest areas and furnishes considerable feed after the first of June. Although the forage in the Coastal Plain as a whole is generally recognized locally as the wiregrass type, observations show that several minor types vary considerably in season of use and in grazing capacity.

Stock laws requiring fencing of grazing animals apply to all counties of the upper Coastal Plain division and about one-half of those in the middle division. None of the counties in the lower division have such laws. Counties without stock laws comprise what is commonly termed "open range country". Cultivated lands comprise nearly 35 percent of the total area in the upper and middle divisions, but only 10 percent in the lower. About 5 percent of this is classed as abandoned farm land (8). Forested lands in the lower division are assessed at 75¢ to $2 per acre, and in the more agricultural counties of the middle and upper divisions, at $3.75 to $6.75 per acre (8). Because of this low value, it can be considered that the average beef producer, particularly in the lower division, is farming on a small scale.

The climate is favorable to rapid growth of vegetation. The summers are long, with an average frost-free period of about 245 days. The average annual rainfall is about 50 inches fairly uniformly distributed throughout the year, although July and August are often wetter than other months.

Cattle Management Practices

Handling Systems

Four general ways of handling herds run on forest ranges, are: 1. yearlong on forest areas without any supplemental feeds, 2. yearlong on forest with supplemental feeds given during the poorest grazing season -- usually from about January 1 to March 1, 3. on forest range from about March 15 to November 1, then on field crops and supplemental feeds, and 4. on forest range together with tame pasture from about March 15 to November 1, and field crops and maintenance feeds during the remainder of the year.

The first two handling systems are common in the lower Coastal Plain division where there is little cultivated land for growing field crops and feeds. The most pressing problems in cattle management on forest lands, on which experimental work is badly needed, appear to be in this area. Cattle on forest range yearlong without supplements are usually in very poor condition during the winter and spring, death losses are high, and the calf crop often below 40 percent. However, farmers handling their cattle this way seldom have much money or time invested in their stock, and they figure that any income from them is almost clear money. The farmers who leave their cattle on the forest range yearlong and give supplemental feeds during the winter, usually give just enough feed to keep the animals living. When handled this way, the calf crop is not much better than when no supplements are given, but death losses are usually not as high. The most common supplements fed on the range are peanut hay, mixed grass hay, and corn shucks. Many farmers have learned from experience that when the forest range is supplemented with feeds of this type the animals lie around waiting to be fed and do not graze the range forage as they should. This particular feeding system is therefore considered unpractical. Whether or not the animals would react this way when fed a concentrated protein feed alone, such as cottonseed meal, is not known. Thus far, concentrated protein supplements alone have not been used on forest ranges in this section.

The last two handling systems, whereby seasonal use is made of forest range, are common in the middle and upper Coastal Plain divisions where there are more field crops and tame pastures and the native forage in the forests becomes browner and is not as well suited for winter grazing. When the cattle are handled in either of these ways the farmers usually have more money and time invested in their herds and expect considerably more income from their cattle. The most common field crops for grazing are corn stalks and velvet beans in the fall, and oats in the winter for green pasture grazing. Most of the tame pastures have been developed and used since 1936.

Very little information is available on the acreage of different kinds of forest range needed per cow, or the kinds of plants that make up the diet at different seasons of the year. Such information is essential to the proper management of grazing lands to determine the season of most profitable use, to maintain forage production, and to know the kinds or amounts of supplemental feeds needed. More familiarity with the different forage types and with the species grazed at different seasons of the year would be of definite value, and studies along these lines are needed. Usually it is estimated that from 5 to 15 acres of cut-over range will support an animal unit for about seven months, from March 15 to October 15. About yearlong grazing still less is known, for it is usually practiced in the open range country where the animals are not confined to a definite acreage. Observations indicate that damage to trees by beef cattle grazing in the longleaf-slash pine type of this area is almost negligible, although studies to determine the extent of tree damage under different rates and seasons of grazing should be made.

Salting and Use of Other Minerals

There is wide variation in salting practices of operators using forest range. Approximately 70 percent of the farmers keep salt before their animals yearlong, 5 percent intermittently, 10 percent only when the animals are in fields, and 15 percent never use salt. Several of the operators not using salt run their animals on open range, and to keep from salting other people's stock they do not put any out. Also, several say that their cattle will not eat salt even if it is made available. General observations bear out this statement. Apparently cattle dependent largely on forest range do not have any great craving for salt. However, cattle do have a craving for certain minerals, particularly phosphorus, this being indicated by their tendency to chew on bones. These observations would indicate that probably phosphorus should be fed alone. At present, mineral mixtures are used by about 20 percent of the forest range operators. Experimental work is needed to determine more specifically what minerals are deficient in the forage, and ways and values of supplying them.

Breeding

Herd improvement in the Coastal Plain of Georgia has been definitely on the increase in the last few years, and the number of piney woods or native animals is decreasing. For a long time, little could be done in the way of improved breeding because better grade animals, introduced from non-infected tick areas, were more susceptible to tick-fever. At present only about 5 percent of the farmers using forest ranges have herds of piney woods cattle only; about 75 percent have herds of mixed grade (cattle showing evidence of improved beef breeding) and native animals. About 15 percent of them have grade herds, and a few have mainly dairy cows with which beef bulls are used. There are a few scattered herds of purebred cattle. Herd improvement is also reflected in the number of good bulls used. At present about 65 percent of the operators are using purebred bulls, 25 percent good quality bulls, and little less than 10 percent are using native bulls. Even though the quality of beef is

improving, there is still considerable demand for low grade meats. There is no question among beef cattle operators about the desirability of having high quality animals where feeds are available for taking care of the cattle during the winter. However, where the cattle are almost entirely dependent on forest range, some farmers believe that low grade cows bred to good bulls make the most profitable herd because they are hardier and keep in better condition during the winter. Experimental work is needed to determine just what quality animals are best suited for forest land grazing operations, particularly those using yearlong forest range.

Nearly 95 percent of the farmers keep their bulls in the herds yearlong and as a result the calves are dropped all seasons of the year. However, most of them are dropped either in early spring or in early fall.

Fattening and Marketing Beef Cattle

Approximately 25 percent of the operators using forest range in producing beef cattle do some fattening. Usually fattening rations are fed for periods of 60 to 120 days. With market conditions as they are at present many farmers are selling calves at about weaning age, thinking that by doing this they save the expense of wintering young animals and any extra winter feeds can be given the cow herd. Also, it is possible that more cows can be kept or the calf crop increased through better winter feeding and in the end more calves could be sold from the farm.

Percentage Calf Crop

As near as the average calf crop can be figured from available information, it amounts to about 40 percent in the lower Coastal Plain Division of Georgia, 55 percent in the middle division, and 70 percent in the upper division. Where considerable attention is given to cattle, these percentages are generally too low for most profitable beef production, and better practices should go a long way in improving the calf crop and profits from the herd.

Tame Permanent Pastures

Nearly all of the tame permanent and improved pastures, mainly of Bermuda grass, carpetgrass, and annual lespedeza, have been developed and used since 1936, and it is likely that in the future considerably more grazing will come from this source. However, it is not likely that they will replace, to any great extent, the grazing of native forest ranges. In fact, many forest ranges may be used more extensively for early spring grazing when tame or improved pastures are developed for summer use.

Forest Range Burning in the Coastal Plain

One hundred percent of the farmers interviewed in the survey state that uncontrolled fires do excessive damage to tree reproduction, therefore they are either trying to keep fires out of their forest areas com-

pletely or are doing some form of controlled or prescribed 1/ burning. A few are giving no attention to fires. The breakdown is about as follows: nearly 60 percent of the farmers using forest lands for grazing are practicing complete fire protection and 40 percent some form of prescribed burning. In parts of the open range country it is difficult to protect against fire because there is a lack of respect for land ownership by those who do not own the land. Burning the other fellow's land to improve grazing for a few cows, destroy boll-weevil, or for some other reason, is a widespread custom. Fires started this way are considered accidental to the owner. Greater use of fences for enclosing both cattle and forest areas probably would go a long way in reducing the number of fires of this type, for then the other fellow does not gain by burning his neighbor's forest land to improve grazing for his cattle. Of those practicing complete protection, approximately half have had no major fires in the past five years, and the remainder have had accidental fires annually or occasionally up to about every four years. This means there are considerably more fires in the forests than is indicated by the number of farmers practicing prescribed burning.

Phases of prescribed burning on the forest range about which questions are most frequently asked, are:

1. Whether it is advisable to prescribe burn the forest range as a measure in avoiding accidental fires, or to practice complete fire protection, especially where main consideration is given to the production of timber.

2. Effect of prescribed burning on forage, cattle gains, tree reproduction, and tree growth.

3. How often prescribed burning should be done, best season, and proper way.

4. Efficiency of prescribed burning in checking brush invasion.

5. Relation of different intensities of grazing to fire hazard and damage.

1/ Burning to a prescription - to accomplish most satisfactorily the purpose of the burn. A few farmers are using the following method of prescribed burning to improve the forage for grazing, with very little apparent damage to the trees.

1. Areas of suitable tree seedling stands are protected against fire until after the young trees are 10 to 15 feet high and are not badly damaged by prescribed burning.
2. After this, any given area is prescribed-burned about every two or three years. This is done by burning portions of the range each year; thus the cattle have some burned range every spring and summer. Spot burning of small areas here and there is preferable to burning over large areas because these scattered fresh burns act as fire breaks if an accidental fire occurs.
3. Burning is done against the wind at night or during very damp periods when the fire will burn slowly.

The three main reasons given by farmers with beef cattle herds for prescribed burning are as follows: 1. to insure against devastating accidental fires, 2. to improve forage for cattle grazing, and 3. to check brush invasion. Nearly 50 percent of those doing some form of prescribed burning are doing it annually and the others at intervals of two or three years. Farmers with small holdings, interested in raising cattle for annual income, and poorly equipped for fire fighting, are often criticized for doing prescribed burning, but when everything is considered they can hardly be blamed for this practice. Part of the criticism is because of poor burning practices. Little research has been done on improved practices in prescribed burning and still less has been published or otherwise made available to the farmers. As a rule accidental fires occur at a time when the fuel is driest, the wind is blowing, and the fires burn hottest and do the greatest damage to the trees. Fires of this type have been described as the most serious menace to the future of forestry in south Georgia (8). Therefore, the farmers feel they had rather prescribe burn and have some damage done to their trees than run the risk of having an accidental fire cause almost complete destruction. Grazed areas usually burn with less intensity than ungrazed ones, and some farmers have cattle primarily because the removal of forage growth through grazing reduces the forest fire hazard. Some farmers practicing prescribed burning on grazed areas are able to get by with burning every third year, whereas without grazing they usually have to burn every year.

The second reason for prescribed burning is to improve the forage for cattle grazing, and there seems to be no doubt that it does help. Although the study conducted at McNeill, Mississippi (9) was not one of prescribed burning, it showed that burning maintained more favorable composition, quality, and quantity of forage than did exclusion of fires. Preliminary studies already made on this project in the Coastal Plain of Georgia bear out the findings at McNeill, Mississippi, and in addition show that the cattle prefer forage on burned areas. In the absence of fire the grazing capacity may decrease as much as one-half in 10 years, according to some of the farmers interviewed. The third common reason for prescribed burning is to check brush invasion on the forest range; brush reduces the grazing capacity and increases the fire hazard. The studies at McNeill, Mississippi, show that gallberries, one of the most common invaders, is readily killed out by annual fires of uncontrolled intensity, but whether or not prescribed fires at less frequent intervals will hold it in check is not known. Experimental studies are needed to find answers to the many questions about the value of prescribed burning in forest range management.

Any conflict between cattle raising and timber management interests is most likely to be in the use of prescribed fires for improving grazing. Even though prescribed burning in the "wiregrass" type is helpful in bringing about good grazing for cattle, it should be done in such a way that the trees are damaged as little as possible. As the trees increase in abundance and size, the grazing capacity of the forest decreases some, of course; but the increase in the value of the trees should more than make up for the loss in grazing.

LITERATURE COVERING EXPERIMENTAL WORK ON FOREST GRAZING

IN THE SOUTHEASTERN UNITED STATES

The literature reveals that very little experimental work bearing directly on forest grazing has been done in the longleaf-slash pine type of the southeastern United States. The most extensive, and also most recent, is that reported on by Wahlenberg, Greene, and Reed, in 1939, "The effect of fire and cattle grazing on longleaf pine lands as studied at McNeill, Mississippi." They report the effects of four land treatments - burned pasture, unburned pasture, burned ungrazed, and unburned ungrazed - on the use of longleaf pine land for cattle grazing as well as for timber production. They found that during a 5-year period, annual winter burning of uncontrolled intensity retarded the growth of longleaf pine sapling trees by about one-fifth in diameter and one-fourth in height. The survival of seedlings after 10 years following a good seed crop, was 43 percent on the unburned, ungrazed area as against not over 5 percent for any one of the other three land treatments. However, because of the brown spot needle disease, none of the treatments were successful in bringing new longleaf pine seedlings out of the grass stage. During this time both the growth and cone production of older trees apparently was little affected.

Annual winter burning of uncontrolled intensity maintained more favorable composition, quality, and quantity of forage than did exclusion of fires. This was reflected in the greater seasonal gains in weight of cattle on the burned area. The authors concluded that while annual winter fires of uncontrolled intensity improved the forage conditions for cattle, the results indicated that successful regeneration of longleaf pine may depend upon some system of periodic controlled burning rather than upon the extremes of annual fires of uncontrolled intensity or fire exclusion, both found unsatisfactory in this study. Burning and grazing did not result in serious soil degradation. The burned-over soils exhibited a slightly favorable chemical characteristics and unfavorable physical characteristics in comparison with unburned soils, although none of these changes appeared to be of any practical significance. The net effect on plant growth of favorable and unfavorable soil changes was not measured.

Some studies have been made in the reed forage type in eastern North Carolina by Foster, Hostetler, and Case (6), and Hostetler, Foster, and Hankins (7). These studies had to do with beef cattle production in general in this area, and with the production and quality of meat of native yearling cattle compared with grade yearlings. Reeds were used for about eight months each year, from about the first of May to the first of January, and represented only 9 percent of the total cost of keeping a cow through the year. The calves were dropped in February, March, and April, and were on reed pastures until weaned about November 15. At this time they usually weighed between 350 and 400 pounds. The pastures were stocked at an average rate of about two acres per animal unit for each season. However, a recent unpublished analysis of the rate of stocking of the pastures for the past 11 years indicates that this rate of stocking

either should be given primary attention. General observations as well as the experiences of many stockmen indicate that the two fit very well together on many cut-over forest areas. Cattle raising furnishes some annual income while the trees are growing to merchantable size, and grazing helps reduce the fire hazard. Some practices that may be beneficial to one purpose may, of course, be detrimental to the other, and vice versa. This can always be expected under any nonintensive management system.

Many problems and questions about effective forest range grazing need research, as was revealed by: 1. the farmers interviewed on the survey, 2. general observation, 3. discussions with persons interested in land use problems, and 4. the literature. The chief of these problems are:

1. To determine practical herd management systems that result in the maximum use of forest range and make for better and more economical wintering of beef cattle, particularly for herds run primarily on forests. Also, to determine the amount of good breeding desirable in herds under different management systems.

2. To determine the place of some form of prescribed burning in forest range management, including best season and best methods.

3. To determine the grazing capacity of various types of forest range, the relative value of the important forage plants through all seasons of the year, and the effects of different degrees and seasons of grazing on the forage, and tree reproduction and growth.

4. To determine the practicability of correlating tame pastures with native forest range grazing, doing artificial reseeding on open forests, and of fertilizing productive forage areas.

5. To determine the need for mineral supplements on the forest range and the value of correcting any deficiencies.

Obviously a research program can not effectively cover all these important problems at any one time, or perhaps even all the different phases of a single problem. Therefore, it is necessary to select one or two of the most practical and important problems and tackle those phases it is thought will yield the quickest and greatest returns to the farmers. Looking at the practicability of forest range grazing from the standpoint of cattle raising alone probably the most important problem is one of economically providing for the cattle through the period from about October 15 to March 15 when they are usually losing

weight. Looking at it from the standpoint of both forage and timber production prescribed burning is the problem of greatest concern to the land owners. Since both of these problems affect practically every farmer using forest lands for grazing, as well as many producing only timber, it seems that they should be given first consideration. In studying them certain phases of other problems necessarily will be touched upon, some rather fully. The experimental tract, where the studies will be conducted, is located two miles south of Alapaha, Georgia, in the upper edge of the lower Coastal Plain and, considering the forage and trees, the area is fairly typical of the region.

OUTLINE OF FOREST GRAZING PROJECT PROGRAM

This section presents the following information about each of the two major subprojects selected for study:

Purpose

Importance of study

Methods

Research aspects

Duration

Certain parts of the methods section will be expanded in more detail as the work develops.

Improving Herd Management Systems to Make More Effective use of Forest Range (Subproject No. 1)

Purpose

To determine practical herd management systems that result in the most effective use of forest range and make for better and more economical wintering of beef cattle, particularly for herds run primarily on forest range. Also, to determine the amount of good breeding desirable in herds under different management systems.

Importance of Study:

In the lower and parts of the middle Coastal Plain there is little land suitable for cultivation and the production of feed crops, and wintering the cattle (i.e. caring for them from about October 15 to March 15) is the most costly operation of the year. The calf crops average about 40 percent, death losses are high, and the cattle are usually in poor condition and are not marketed to good advantage. It appears that this condition could be improved and the cost of wintering reduced considerably by making more effective use of the forest range during much of this time. Native forage is usually cheap feed, and it should be used to the greatest advantage to shorten the wintering season and lessen the cost of harvested feeds.

The practicability of different management systems, no doubt, depends partly on the type of animals kept on the range. Many cattle on forest range are of low quality, and many farmers believe that animals of this type are best suited to range conditions because they are hardier and maintain better condition than do well bred animals. On the other hand, some maintain that if the animals are given more care during the critical feed deficiency seasons the better grade animals are more profitable. More information on the quality of animals best suited to range conditions is definitely needed.

Methods

Field Procedure and Records.

1. Divide 60 native range cows and 20 good grade Hereford cows into four equal groups or herds on the basis of grade, weight, and condition and manage each as follows:

Group 1

Herd of 15 native and 5 good grade Hereford cows to be grazed on 300 acres of forest range from March 15 to February 1, with a supplement of cottonseed meal given after October 15. To avoid labor, the cows will be fed only three times each week — 4 2/3 pounds each feeding. This amount is equal to two pounds each day. From February 1 to March 15 the cows will be in a dry-lot and fed a maintenance ration as explained later.

Group 2

Herd of 15 native and 5 good grade Hereford cows to be grazed on 300 acres of forest range from March 15 to February 1, with a supplement of cottonseed meal given after October 15, exactly as with group 1. From February 1 to March 15 the cows will be on additional range and fed cottonseed meal as before. In other words, this group will be on range yearlong and fed cottonseed meal from October 15 to March 15. Treatment of this group differs from the first only for the period of February 1 to March 15.

Group 3

Herd of 15 native and 5 good grade Hereford cows to be grazed on 300 acres of forest range from March 15 to February 1, with a supplement of cottonseed meal given after October 15. The cows will be fed 2 1/3 pounds three times each week. This amount is equal to one pound each day. From February 1 to March 15 the cows will be in a dry-lot and fed a maintenance ration as

explained later. The only difference in treatment of this group and group 1 is in amount of cottonseed meal fed from October 15 to February 1 -- this group receives only one-half as much cottonseed meal as does group 1.

Group 4

Herd of 15 native and 5 good grade Hereford cows to be grazed on 300 acres of forest range from March 15 to February 1 without any supplement (to serve as check on groups 1 and 3). Group 1 will serve as check on group 2, since there is only one difference in the treatment of these two groups. From February 1 to March 15 the cows will be in a dry-lot and fed a maintenance ration as explained later.

Diagrammed the management systems are as follows:

Group 1	Range alone	Range + cottonseed meal at rate of 2# per day	Dry-lot	
Mar. 15		Oct. 15	Feb. 1	Mar. 15

Group 2	Range alone	Range + cottonseed meal at rate of 2# per day	
Mar. 15		Oct. 15	Mar. 15

Group 3	Range alone	Range + cottonseed meal at rate of 1# per day	Dry-lot	
Mar. 15		Oct. 15	Feb. 1	Mar. 15

Group 4	Range alone	Dry-lot	
Mar. 15		Feb. 1	Mar. 15

2. Groups 1, 3 and 4

These groups will be placed in separate dry-lots and each fed the same maintenance ration from February 1 to March 15. The maintenance rations may be composed of different kinds of feeds from

months. The bulls will be alternated between the cow herds from year to year so as to avoid breeding one herd continuously to a superior or inferior performing animal. In this respect it would be well to use the same bulls for four years straight, thus each bull would be with each herd one year.

6. To begin the experiment, a mixture of equal parts of salt, limestone, and bonemeal will be available to each herd. Although the exact value of adding this to the diet is not known, and it is not feasible to determine at present, it is thought advisable to keep it before the animals all the time for everything indicates that certain minerals are needed. General observations indicate that cattle on forest range alone have little or no craving for salt but do have a marked craving for phosphorus.

7. Prescribe burn one-third of each pasture every year, about the first of January for improving grazing. Any particular portion will be burned every three years. The burning in each pasture to be in two separated spots each year.

8. One square enclosure, one-fourth acre in size, will be placed at random in each one-third of a pasture and staked. Another plot will be paired with each of these and fenced, making a total of 3 unfenced and 3 fenced areas in a pasture.

9. In each unfenced and fenced area, will be placed at random two plots 6.6 x 6.6 feet in size (border strip within each unfenced or fenced enclosure of 19.8 ft.) on which the following measurements will be made each fall: (The initial measurements should be made before any prescribed burning is done.)

   a. Foliar density and the composition of herbaceous plants on the plots will be estimated and height measurements taken.

   b. Foliar density and composition of shrubby plants on the plots will be estimated and height measurements taken.

   c. Any tree grazing or other damage done by the cattle will be noted and recorded.

   d. Degree of utilization will be estimated.

10. A larger plot, 66 x 6.6 feet will be placed across the 6.6 x 6.6 feet plots on which the seedlings and young trees will be counted, classified into height groups,

and measured. The groups are 0 - 1', 1' - 4', 4' - 8', and 8' - 12'. If the trees are above 12' in height they will be classified into diameter groups d.b.h. The groups are 0 - 3", 3" - 6", 6" - 9", 9" - 12", and 12" - up.

11. All animals (including calves) will be weighed individually at the beginning of the experiment and on the following dates each year.

October 15 - - - At start of supplemental feeding.
December 10 - - - Midway of supplemental feeding period.
February 1 - - - At time they go into the dry-lot.
March 15 - - - - At time they go onto the range.
May 15 - - - - - About peak of forage growth.
July 1 - - - - - About end of best grazing season.
September 1 - - - About midway to supplemental feeding period.

The initial weights of the cows will be the average of weights taken on three consecutive days (this weight will be the one used in dividing the animals at the start of the experiment). The animals will be graded when weaned. During the course of the experiment the animals will be weighed only one time at each weigh period.

12. Birth weights of the calves will be obtained.

13. Daily feed records will be kept, as well as cost records and financial returns of the different methods of handling the herds.

14. Blood samples for analyses will be taken from about 5 cows in each herd every year about October 15.

15. Observations of grazing habits will be made bi-weekly when the animals are in the pastures. This will include the following:

a. Where the animals tend to do most of their grazing.

b. Time of day they graze.

c. Species and portions of plants grazed.

16. Collect pure samples of the important forage species (perhaps 5 or 6 to begin with) in four or five different stages of development and analyze in the laboratory. The number of samples collected will be determined in part by how many samples can be handled in the laboratory.

17. In the fall before any treatments are started, 300 temporary plots, each 6.6 x 6.6 feet in size, will be placed according to a randomized block system in each of the pastures and the seedlings and young trees counted, classified into height groups, and measured. The groups are 0 - 1', 1' - 4', 4' - 8', and 8' - 12'. If the trees are above 12' in height, they will be classified into diameter groups d.b.h. The groups are 0 -3", 3" - 6", 6" - 9", 9" - 12", and 12" - up. These measurements should be made about every three years.

18. A permanent photo station will be placed on a fence line of each of the three fenced enclosures in each of the pastures. Pictures will be taken at the start of the experiment and as often as desired thereafter to show results. In evaluating the different management systems and practices, consideration will be given to the following comparisons:

1. Percentage calf crop, birth weights, and value of calves at weaning time as follows:

   (a) from each herd, (b) from grades of cows in each herd, (c) by grades combined and, (d) from different ages of cows.

2. General condition, grade, and weights of the cows by herds, and by whether native, good grade Herefords, or crosses, and the value of any cows sold.

3. Development of replacement heifers by herd management systems, and by grade of animal.

4. Amounts of salt and other minerals consumed by each herd.

5. Full costs and returns from the different herds, and also the different grades.

6. Blood samples from each herd.

7. Grazing habits, i.e., how and where they tend to graze when managed according to these different systems, and the effect of grazing on reproduction.

8. Forage species taken under the different management systems.

9. Changes in tree seedling stands and rate of seedling

and tree growth under each condition.

Research Aspects

In order to clarify some of the points listed under field procedure this section is presented.

1. It is proposed not to replicate this experiment at the present time. Ordinarily it would be highly advisable to replicate, but it is thought best to delay this for a while because of the large set-up involved, limited facilities, urgent need during war times for experiments of a demonstrational nature, data on as many management practices as possible, and limited available information. Not enough research has been done, nor is information available at present, to indicate which of the four management practices might be most feasible, or yield the most profitable results. However, the set-up is arranged so that two of the practices can be discontinued and two replicated whenever it seems desirable.

2. All four of the herd management systems to be tested are considered improved practices, for many farmers leave their cattle on forest range yearlong without any supplements. Later on it may be advisable to run one group on forest range yearlong without any supplements to determine more specifically what happens under this condition, especially since many farmers handle their cattle this way.

   Other treatments to be tested soon and that should yield worthwhile information are as follows:

   a. A part of the range deferred during the summer for grazing after October 15.

   b. Supplementing forest range after mid-summer with improved pasture.

   c. Yearlong on forest range, where one-third is burned annually.

   d. Yearlong on forest range, where one-third is burned annually, but with the animals fenced off of the burned portion from about February 1 to March 15.

   e. On forest range from March 15 to October 15, on corn stalk and velvet bean fields during late fall and early winter, and green oat pasture and maintenance feeds the remainder of the year.

3. Each of the pastures will be 300 acres, thus allowing 15 acres for each of the 20 cows in a herd. It is judged that about 7 or 8 acres of this type of range per cow is

sufficient for grazing from about March 15 to October 15, but since there is only limited plant growth during the remainder of the time, nearly double the acreage will be required for the full season. It is hoped there will be no scarcity of pasturage with this rate of stocking and if observations show a deficiency, the number of animals in each pasture will have to be reduced.

4. So that grazing in all the pastures will be about equal, group 2 will be on additional range from February 1 to March 15 while the other herds are in dry-lots. There will not be any burned range available to group 2 between February 1 and March 15.

5. The period from the first of February until about the middle of March is considered most critical, since most death losses occur on the range during that time and it appears that it might be well to keep the cattle in a dry-lot and feed them a maintenance ration. Cattle on range during this period often have access to an insufficient acreage of burned range, and because they prefer the new succulent forage that starts growth here in February to that on unburned areas they may nearly starve themselves trying to graze the slowly growing new forage. It is thought that most farmers now using forest range yearlong would be ahead by feeding a maintenance ration during this period.

6. It is thought best to have the calves begin dropping soon after the cows go into dry-lots for the following reasons:

   a. Animals in the dry-lots can be looked after more easily at calving time.

   b. When the cattle are turned in the pasture the calves will soon be large enough to graze some of the new forage.

   c. Calves can be weaned before the feed in the pastures become too poor.

   d. Cows in the dry-lots can be fed enough to start a milk flow, and when turned in the pastures the new forage should maintain it.

Duration

Feeding phases should be carried through at least 3 full seasons, and breeding phases 6 to 8 years.

Prescribed Burning of Cut-over Forest Lands as a Practice in Forest Range Management (Subproject No. 2)

Purpose

To compare and evaluate the effects of different frequencies of prescribed burning on forage, cattle and trees, as follows: 1. Prescribed burning one-third of the range each year. 2. Prescribed burning one-half of the range each year. 3. Prescribed burning all of the range each year. 4. Total protection of the forest range.

Importance of Study

Many farmers burn portions of their forest range each year without very much information regarding best practices, or the good or ill effects produced. Many fires are carelessly set and allowed to burn without any attention and consequently do severe damage to tree reproduction. Some operators that have protected their forest areas against fires for the past several years plan to start some form of burning in the near future. More information about proper methods in prescribed burning, and its affects, should go a long way in improving both cattle production and forest stands.

Methods

Field Procedure and Records.

1. Divide 24 yearlings and 24 two-year-old steers, produced in the cow herds of experiment No. 1, into eight equal groups on the basis of past treatment, grade, weight, and condition, and graze each group on 48 acre pastures from about March 15 to October 15 as follows. (All steers will have to be purchased the first year, and the two-year-olds the second year.)

   Groups 1 and 2

   On unburned pastures.

   Groups 3 and 4

   On pastures where one-half is prescribed burned each year -- each particular half is burned every two years.

   Groups 5 and 6

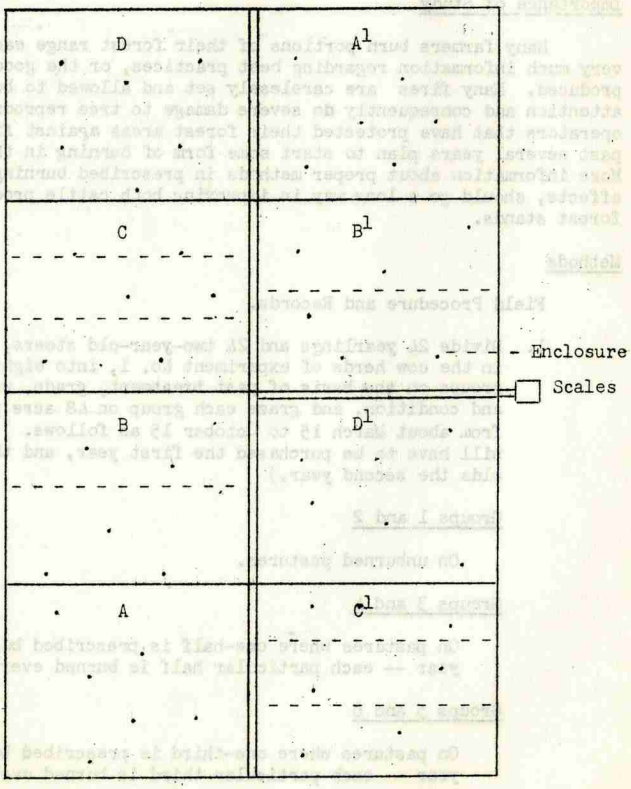
   On pastures where one-third is prescribed burned each year -- each particular third is burned every three years.

PRESCRIBED BURNING EXPERIMENT

Pastures 48 acres in size - 6 steers in each pasture - grazed from March 15 to October 15.

Treatments:

A-A[1] - Pastures unburned
B-B[1] - Pastures one-half burned each year
C-C[1] - Pastures one-third burned each year
D-D[1] - Pastures completely burned each year



Groups 7 and 8

On pastures that are completely prescribed burned each year.

2. The 8 pastures to be used in this study were located, and the burning treatments assigned later at random.

3. Six one-fourth acre square enclosures will be placed at random in each of the pastures (exclusive of swamps) and staked. Other plots will be paired with each of these and fenced, making a total of six unfenced and six fenced enclosures in each pasture. In the pastures where one-half and one-third is prescribed burned each year distribute the plots equally over the portions burned at different times.

4. In each unfenced and fenced area will be placed at random two permanent plots 6.6 x 6.6 feet in size (border strip within each unfenced or fenced enclosure of 19.8 feet) on which the following measurements will be made each fall: (The initial measurements should be made before any prescribed burning is done.)

   a. Foliar density and composition of herbaceous plants on the plots will be estimated and height measurements taken.

   b. Foliar density and composition of shrubby plants on the plots will be estimated and height measurements taken.

   c. Degree of utilization will be estimated.

5. A larger permanent plot, 66 x 6.6 feet, will be placed across each of the 6.6 x 6.6 feet plots on which seedlings and young trees will be counted, classified into height groups, and measured. The groups are 0 - 1', 1' - 4', 4' - 8', and 8' - 12'. If the trees are above 12' in height they will be classified into diameter groups d.b.h. The groups are 0 - 3", 3" - 6", 6" - 9", 9" - 12", and 12" - up.

6. In the fall before any treatments are started, 300 temporary plots, each 6.6 x 6.6 feet in size, will be placed according to a randomized block system in each of the pastures and the seedlings and trees will be counted, classified into height groups, and measured. The groups are 0 - 1', 1' - 4', 4' - 8', and 8' - 12'. If the trees are above 12' in height, they will be classified into diameter groups d.b.h. The groups are 0 - 3", 3" - 6", 6" - 9", 9" - 12", and 12" - up. These measurements should be made in the fall about every three years.

7. Two permanent photo stations will be located in each of the pastures, one from a corner of a staked enclosure and the other from a similar position in the paired and fenced enclosure. Pictures should be taken here before any prescribed burning is done and thereafter as often as needed to show results.

8. The prescribed burning will be done in late December or early January, under conditions that will do as little damage to the trees as can be expected. In the pastures where one-half and one-third is burned each year, the pastures will be divided into equal portions and definite areas burned. Experimentally, this will be an advantage because all ages of stands will likely be burned, thus making it possible to study the effects of different frequencies of burning on different ages of trees. In actual practice probably it would be advisable to spot burn, and get only those areas where the trees are as much as 12 feet high.

9. Observations of grazing habits and samples for chemical analysis will be made by-weekly when the animals are in the pastures, as follows.

   a. Where the animals tend to do most of their grazing.

   b. Species and portions of plants grazed.

   c. During each observation period collect a sample of forage representative of cattle diet, composite these by pasture treatments for the full season, and make chemical analysis of the forage.

10. On two of the staked 6.6 x 6.6 feet plots under each condition take plant development measurements every two weeks throughout the year.

11. Every animal will be weighed individually at the beginning of the experiment and at 28-day intervals thereafter. The initial weights will be the average of weights taken on three consecutive days before starting any treatments (this weight will be the one used in dividing the animals at the start of the experiment). The animals will be graded both before dividing into groups and at the end of the grazing season.

12. To begin the experiment, a mineral mixture consisting of equal parts of salt, limestone, and bonemeal will always be available to each herd.

13. Soil samples will be taken for chemical and physical analysis representing each condition of grazing and burning, as follows:

a. Take two borings 0 - 3" and four 3" - 10" from each half of each unfenced and fenced enclosure.

b. Composite all the 0 - 3" borings from the east side of the unfenced enclosures, and all those from the west side in each pasture to make two samples at this depth for the unfenced enclosures. Do same for fenced enclosures, to make a total of four 0 - 3" samples at this depth from each pasture. Repeat for 3" - 10" depth. These samples should be taken before any treatments are started. and as often thereafter as needed to show results.

Comparisons to be made.

The different systems of management to be compared are as follows:

1. Areas protected from prescribed fires and ungrazed.

2. Areas protected from prescribed fires and grazed.

3. Areas burned every two years and ungrazed.

4. Areas burned every two years and grazed.

5. Areas burned every three years and ungrazed.

6. Areas burned every three years and grazed.

7. Areas burned every year and ungrazed.

8. Areas burned every year and grazed.

In evaluating these treatments, consideration will be given to the following:

1. Changes in composition, yield, and nutritional qualities of forage.

2. Numbers of tree seedlings killed and effect on growth of older trees.

3. Beneficial or detrimental effects on soils.

4. Cattle gains and condition under each of the four sets of grazing conditions.

5. Returns from different management systems.

Research Aspects

1. Even though a cattle program consisting of using breeding cows and either producing calves that can be marketed at weaning age or feeder animals appears best suited for this area, steers will be used in this experiment because they are less trouble to handle, and since they are in the growing stage, the amount of gains they make is probably the best index of the comparative value of the forage in producing beef.

2. The experimental set-up will not provide answers to many of the questions asked about prescribed burning. For example, it will not answer the question concerned with the season to prescribe burn to obtain the best forage and cattle gains. Some observations made last winter indicate that it might be possible to prescribe burn in early fall and have good early winter grazing. This important phase of prescribed burning must wait for later consideration.

3. Because of the question concerning the amount of good breeding desirable in animals run primarily on forest range it will be well to have about an equal number of crosses and good grade steers in each pasture. The gains of these different grade animals can then be compared.

Duration

The treatments should be continued for at least nine years. All portions of the pastures will then have been burned over at least three times.

PREPARATION OF REPORTS

Each year a progress report presenting data collected on the project up until about October 15, will be completed about the first of December. In so far as possible the data shall be kept compiled throughout the year.

After the major experiments have been going three full years progress reports presenting practical information, useful to farmers, will be prepared for publication. Sufficient useful information should be available after this time to prepare bulletins on the following.

1. Comparative value of four different management systems in wintering beef cattle run primarily on forest range.

2. Extent of breeding quality desirable in beef cattle herds run primarily on forest range.

3. Comparative value of fire exclusion and of prescribed burning one-half, one-third, and all of the forest range each year.

Reports will be prepared by representatives of the different cooperating agencies, and so far as possible all phases of the studies, including animal, forage, and trees, will be presented together.

Technical papers dealing with individual aspects of the investigations also will be prepared for scientific journals. These will be prepared as rapidly as material becomes available.

Short articles presenting practical information will be prepared occasionally for livestock journals.

RESPONSIBILITY

Technical supervision of the project will be under B. L. Southwell for Animal Husbandry phases, and H. H. Biswell for forage and forestry phases. The field and laboratory work will be under the immediate direction of Animal Husbandry, Forestry and Chemistry Technicians. The Animal Husbandry Technician will be living on the experimental tract and will care for the structural plant and equipment and act as general superintendent on the area.

STUDIES OF HIGH PRIORITY TO BE UNDERTAKEN LATER

As the subprojects outlined are well underway, others will be planned and work started. Some of the problems of high priority to be undertaken later are as follows:

1. To determine the best season to prescribe burn to improve the forage for grazing.

2. To determine the effect of different degrees of grazing on forage and on tree stands.

3. To study the kinds and extent of mineral deficiencies and ways and values of correcting them.

4. To study the kinds of poisonous plants, their distribution, abundance, poisonous properties, and the most practical solution to this problem.

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NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

PROJECT OUTLINE

Project No.	P.14-A13
Date Submitted	
(1) Approved	
Revised	

1. Title

Effects of Heavy Grazing and Moderate Grazing on Reeds and on Cattle Gains at Hofmann

(New Subproject Phase IV.)

2. Objective(s)

To find the effects of heavy and moderate grazing on dense vigorous reeds and on cattle gains, and to develop "yard-sticks" for judging utilization (to be done at the Blackland Branch Station).

3. Reasons for Undertaking Investigations*

Studies of the effects of two degrees of grazing on logged and unlogged areas are already in progress at the Hofmann Forest. However, properly stocking reed areas to prevent over grazing and killing the reeds and to produce maximum cattle gains is one of the biggest problems in their proper management. Additional studies are needed at the Blackland Branch Station, therefore, where the reeds are of higher grazing value than those at the Hofmann Forest. Previous studies have shown that reeds are easily killed if over grazed during the summer but more information is needed on optimum rate of stocking for maintaining vigor in reeds and for best cattle gains. If "yard-sticks" can be developed whereby the proper use of reeds can be determined in different types of stands it will be possible to avoid overgrazing, killing the reeds, and destroying the grazing capacity of forage ranges.

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(1) This subproject was approved as a part of the project analysis and working plans - second revision March 1945 - "The role of forest grazing in beef cattle production in the southeastern United States".

*Including economic justification

4. Previous work and present status of investigations in the field of this project:

Studies of grazing and beef cattle production in the reed or switch cane forage type have been carried on at the Blackland Branch Station in eastern North Carolina for the past 18 years by state agencies, and state and federal agencies cooperating. Some of the results are reported in publications by Foster, Hostetler, and Case (13) and Hostetler, Foster, and Haskins (16). These studies had to do with beef cattle production in general in the reed forage type, and with the production and quality of meat of native yearling cattle compared with grade yearlings. Reeds were used for about 8 months each year, from about the first of May to the first of January, and represented only 9 per cent of the total cost of keeping a cow through the year. The pastures were stocked at an average rate of about 2 acres per animal unit for each season. However, an unpublished analysis made of the rate of stocking of the pastures for 11 years indicates that this rate of stocking (average of 2.1 acres per animal for 11-year period) was too high for sustained yield. At the end of 11 years many of the reeds were killed by heavy grazing and some of the pastures had decreased to about half in grazing capacity.

(See Project Analysis and Working Plans for additional literature references Pages 7-10).

5. Outline of Procedure:

Field Procedure and Records:

1. The six 15-acre steer pastures that were used in the rotation grazing subproject (closed out) will be used for this study. The treatments will be run in triplicate and the rates of grazing will be 4 or 6 cows and their calves per pasture (See figure on page 14). The forage in these pastures was not changed appreciably as a result of previous use in the rotation grazing experiment. However, a fire burned the muck soil in the end of some of the pastures so that two of them appeared better than the others. In addition, two of the remaining four pastures were also slightly better than the two poorest ones. As a result of these differences the pastures were grouped by two's and the treatments assigned at random.

2. Divide 30 cows and their calves into uniform groups about May 15 and graze them on pastures until about November 15. (The calves from this subproject will be used in subproject No. 6 - Wintering Calves on Reeds.)

3. At the beginning and close of each grazing season, the animals will be graded by a committee. The cows will also be graded according to condition and vigor, and the calves appraised. All cattle will be weighed individually at the beginning and close of a test and at 28-day intervals during a grazing period. The initial and final weights used will be, where practical, the average of those taken on three consecutive days at the beginning and close of a grazing season.

4. Pictures will be taken of typical animals in the various treatments at the beginning and the close of each grazing season.

5. The forage in each pasture will be sampled (4 plots per pasture) at the beginning and end of each grazing season for composition, density, and vigor. Degree of forage utilization will be measured at the close of each grazing season.

6. General observations of utilization, and stage of growth of the important species will be made and recorded each 28-day weight period, with any other general notes of differences between pastures or groups.

Statistical Analysis:

CATTLE (for one year)

Source of variation	d.f.
Intensity	1
Replications	2
Replication x intensity	2
Cows in groups	24
Total	29

FORAGE (for one year)

Source of variation	d.f.
Intensity	1
Replications	2
Replication x intensity	2
Plot locations	18
Total	23

6. Probable Duration of Project: At least three seasons.

7. Date of Initiation: May 1945

8. Personnel:

Name	Department	Relation to Project
J. E. Foster	Animal Industry (An. Husb.)	Leader
H. H. Biswell	Appalachian Forest Experiment Station	Leader

9. Coöperation:

a. Interdepartmental

b. Other Agencies

Bureau of Animal Industry
U. S. Department of Agriculture and
North Carolina Department of Agriculture.

10. Financial Support:

a. Proposed Budget 7-1-45 to 6-30-46

Items	ALLOCATION OF FUNDS					
	Bankhead-Jones	Purnell	Adams	State	Other	Total
1. Salaries						
2. Labor						
3. Travel		$150				
4. Equipment & Supplies						
5. All Other						
Total		$150				

b. Proposed Future Budgets: Same as this year

Year	Salaries	Total Expenditures	Estimated Income

11. General Remarks: This project financed, except for travel, by S. C. Dept. of Agriculture and by Bureau of Animal Industry U.S.D.A.

Project No. P.14-ai-3 Sub II

SIGNATURES OF APPROVAL

1. Approval of Project Leaders

Date Mar. 1, 1945 J. E. Foster

Title In Charge Beef Cattle & Sheep Research

Date .....

Title .....

Date .....

Title .....

2. Approval of Heads of Departments or Cooperating Agencies

Date 3-2-45 Earl N. Hostetler

Head, A. H. Section

Date 3-5-45 [illegible]

Head, Dept. of Animal Industry.

Date .....

Head, ...

3. Approval of Committee on Experiment Station Projects

Date .....

Chairman of Committee

4. Approval of Director

R. D. Baver

Date .....

Director, North Carolina Agricultural Experiment Station

5. Approval of U. S. D. A.

E. V. Elting

Date .....

Assistant Chief, Office of Experiment Stations

Forest Grazing

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

PROJECT OUTLINE

Project No. P-14-A13
Date
Submitted .....
(1) Approved .....
Revised .....

1. Title

Use of Reeds in Finishing Yearling Steers

(New Subproject Phase V.)

2. Objective(s)

To determine the practicability of finishing yearling steers completely or partially on reed areas by the addition of concentrated supplemental feeds after August 1, rather than finishing entirely in the dry lot (to be done at the Blackland Branch Station).

3. Reasons for Undertaking Investigations*

Finishing yearling steers in the dry lot after about November on corn, soybean hay, and cottonseed meal has proved to be rather expensive. It is quite possible that it would be cheaper and more practical to finish or partially finish yearling steers by feeding them concentrated supplemental feeds on reed areas where there is an abundance of forage.

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(1) This subproject was approved as a part of the project analysis and working plans - second revision March 1945 - "The role of forest grazing in beef cattle production in the southeastern United States".

*Including economic justification

4. Previous work and present status of investigations in the field of this project:

Studies of grazing and beef cattle production in the reed or switch cane forage type have been carried on at the Blackland Branch Station in eastern North Carolina for the past 18 years by state agencies, and state and federal agencies cooperating. Some of the results are reported in publications by Foster, Hostetler and Case (13) and Hostetler, Foster, and Hankins (16).

The experiments comparing the cost of producing grade versus native cattle showed that the gains of the former were about $1.31 per cwt. cheaper. When the cattle were on reed pastures during the summer the calves from the grade animals gained 0.14 pounds more per head daily than those from the native cattle and weighed 53 pounds more when weaned in November.

Studies on the digestibility of reeds by Blackmon (8) showed that the digestible nutrients furnished to cattle that are grazing good reeds in June ranges from 52.2 to 57.6 pounds per 100 pounds of reeds consumed on a moisture free basis, averaging 55.05 for four sets of data. On a green weight basis, this places the T.D.N. value at 12.42 pounds per hundred-weight. This means that the T.D.N. of reeds compares very favorably with that of other green feeds.

(See Project Analysis and Working Plans for additional literature references Pages 7-10).

5. Outline of Procedure:
Field Procedure and Records.

1. The areas used in the creep feeding subproject (closed out) and those used for the heifers in the rotation grazing subproject (also closed out) at the Blackland Branch Station will be used for this study. The steers will be shifted among the areas so that plenty of forage will always be available, and in such a way as to alleviate pasture differences.
2. Graze 30 steers together on reed areas from about May 15 to about August 1 and then divide them into three uniform groups and graze and feed as follows:

Group 1.

Graze 10 steers on reed areas from About August 1 to November 15 and then finish them out in the dry lot on shelled corn and shredded corn stover full fed, cottonseed meal 2 pounds per head daily, and soybean hay 5 pounds per head daily. This procedure has been carried on for several years at the Blackland Branch Station, and the results for 1941-42, 1942-43, and 1943-44 have been written up and published (14). The 1944-45 group completes another finishing trial in April 1945. This group of steers will serve as a check on the other two.

Group 2

Finish out 10 steers on reed areas after about August 1 by full feeding them a concentrated supplement of 5 pounds of cottonseed meal per head daily and a full feeding of ground corn.

Group 3

Finish out 10 steers on reed areas and in the dry lot by feeding them the same as group 2 from about August 1 to November 15 and then handling and feeding them the same as group 1 until they are finished.

3. All steers will be weighed individually at the beginning and end of each trial and at 28-day intervals. Where practical the initial and final weights used will be the average of those taken on three consecutive days at the start and close of each trial. Each animal will be graded according to the U. S. Grading System by a committee about August 1 and again when finished. Additional grades will be taken when the steers in groups 1 and 3 are put in the dry lot.

4. Daily feed records as well as complete cost records and financial returns of the different methods of handling the groups will be kept throughout the period. Pictures of representative animals will be made about August 1, about November 15, and at the end of the finishing periods.

5. Every 28 days (weigh periods) measurements will be made of degree of grazing, kinds and amounts of forage available, and observations of cattle condition.

Statistical Analysis.

CATTLE (for one year)

Source of variation	d.f.
Between groups	2
Steers in groups	N - 3
Total	N - 1

6. Probable Duration of Project: At least 3 full years.

7. Date of Initiation: May 1945.

8. Personnel:

Name	Department	Relation to Project
J. E. Foster	Animal Industry (An. Husb.)	Leader
H. H. Biswell	Appalachian Forest Experiment Station	Leader

9. Coöperation:

a. Interdepartmental

b. Other Agencies

Bureau of Animal Industry
U. S. Department of Agriculture, and
North Carolina Department of Agriculture.

10. Financial Support:

a. Proposed Budget 7-1-45 to 6-30-46

Items	ALLOCATION OF FUNDS					
	Bankhead-Jones	Purnell	Adams	State	Other	Total
1. Salaries						
2. Labor						
3. Travel		$150				
4. Equipment & Supplies						
5. All Other						
Total		$150				

b. Proposed Future Budgets: Same as this year

Year	Salaries	Total Expenditures	Estimated Income

11. General Remarks: This project financed, except for travel, by N. C. Dept. of Agriculture and By Bureau of Animal Industry U.S.D.A.

Project No. P14-ai 3 (Sub V)

SIGNATURES OF APPROVAL

1. Approval of Project Leaders

Date Mar. 1, 1945 .... J. E. Foster

Title In Charge Beef Cattle & Sheep Research

Date ....

Title ....

Date ....

Title ....

2. Approval of Heads of Departments or Coöperating Agencies

Date 3-2-45 .... Earl H. Hostetler

Head, A. H. Section

Date 3-5-45 .... J. H. Hilton

Head, Dept. of animal industry.

Date ....

Head, ...

3. Approval of Committee on Experiment Station Projects

Date ....

Chairman of Committee

4. Approval of Director

Date ....

Director, North Carolina Agricultural Experiment Station

5. Approval of U. S. D. A.

Date .... E. C. Elting

Assistant Chief, Office of Experiment Stations