GENERAL STUDY PLAN

RESTORATION OF BROWSE ON GAME RANGES BY ARTIFICIAL METHODS

1. Introduction

Browse is a major item in the diet of big game animals like deer and antelope. It is especially important on snow-covered winter ranges where often it is the only feed available to the animals. Some browse species are also valuable as cover and afford protection to the animals from predators and the elements. In California, browse has been greatly reduced on many game ranges because of heavy grazing by both game and livestock, and because of fire, insect depredation, and other causes.

The California Forest and Range Experiment Station has undertaken a cooperative State-wide research project with the California Department of Fish and Game, to develop artificial reseeding and other cultural methods of restoring browse on game ranges where the browse has been greatly reduced or eliminated and where natural regeneration is unlikely in the next 50 years. Particular attention will be given to restoration on deer winter ranges.

2. General Scope of Studies

The major lines of work to be undertaken in these studies follow:

A. Suitable species

(1) Find desirable native and introduced species and varieties of browse that will grow on the range. Consider palatability, yield, growth habit (sprouting or non-sprouting), and ease of collecting and processing seed in initial screening of species. Consider using some species as nurse plants.
(2) Conduct life history studies of the most promising species --
paying particular attention to reproduction, seed germination, palat-
tability and nutritional value to game and livestock resistance to
grazing, and susceptibility to injury by rodents, insects, diseases
and fire.

(3) Determine criteria for judging the sites to which the various
species are adapted.

(4) Develop seed collecting and cleaning techniques.

B. Site preparation for planting

(1) Develop methods for reducing or eliminating competition by vege-
tation from planting sites by

   (a) Mechanical means
   (b) Chemical means
   (c) Fire
   (d) Grazing

(2) Develop methods of preparing the site for seeding or planting.

C. Seed and seedling protection

(1) Develop methods of protecting the planted seed and the young
seedlings during the period of establishment (first 4 years) from

   (a) Rodents
   (b) Insects (tent caterpillars and others)
   (c) Birds
   (d) Others that may show up

D. Planting methods

(1) Develop suitable seed and planting procedures

   (a) Machinery and other equipment
   (b) Species mixtures, rates and spacings of shrubs, grasses and
        forbs

3. Initial Studies

The first studies will be confined to the Great Basin area of the State,
locally called the Eastside Region, and limited largely to bitterbrush
(Purshia tridentata), the most important and widespread browse on Eastside ranges (1, 2, 3, 4). The Eastside region supports a heavy population of Rocky Mountain mule deer, who depend heavily on bitterbrush, especially on the winter ranges. Bitterbrush is also grazed closely by cattle, sheep, deer and antelope. It is killed in practically all cases by fire. Two or three successive defoliations by tent caterpillars also kill the plant and close grazing interferes with its reproduction. These factors and others acting singly and in combination have eliminated the species on extensive areas and reduced and weakened the stands on others.

The present studies will be undertaken in Modoc and Siskiyou Counties in the heart of the winter range of the Oregon-California Inter-State Deer Herd. Here browse -- bitterbrush in particular -- has been all but eliminated by deer and livestock grazing, fires, and tent caterpillars. Much of the range is now heavily clothed with cheatgrass.

The two major hurdles involved in these studies are:

A. Eliminating or reducing competing vegetation on the planting sites.

B. Protecting the seeds and young plants on the experimental plots from being destroyed by deer, livestock, rodents, and insects.

The effectiveness of discing and burning in reducing competition on the planting site will be tested. Some plots will be fenced against deer and livestock and possibly rabbits to prevent destruction of experimental seeds and seedlings. The need for fencing out rabbits will depend on whether or not they can be controlled by other methods such as poisoning. Suitable control measures will be taken against other rodents and against tent caterpillars if needed. In these initial tests some information will be obtained on the possibility of establishing bitterbrush in the face of heavy uncontrolled and also controlled grazing by livestock and deer. Some plots, therefore, will be subjected to grazing.
4. Experimental Plan

Sites: 2
Areas: 5
Plot treatments: 13
Sub-plot treatments: 3
Treatment replications:
  Within years: 2
  Overtime: 3

A. Sites

(1) Sagebrush-juniper type with heavy cheatgrass understory located in the heart of the winter deer concentration area.

(2) Sagebrush-juniper-pine type supporting mainly perennial forbs and grasses in the understory located near the margin of the winter deer concentration area.

B. Areas

Four areas will be established in the cheatgrass site and one in the bunchgrass site. They will be about 40 acres in size and will be constructed and grazed as follows:

<table>
<thead>
<tr>
<th>Cheatgrass Site</th>
<th>Bunchgrass Site</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area No.</strong></td>
<td><strong>Year</strong></td>
</tr>
<tr>
<td>1</td>
<td>1952</td>
</tr>
<tr>
<td>2</td>
<td>1952</td>
</tr>
<tr>
<td>3</td>
<td>1952</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

1/ See Figure 1 for grazing schedules.
Figure 1. - Grasing Schedules

<table>
<thead>
<tr>
<th>Year</th>
<th>Livestock (summer)</th>
<th>Deer (winter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>( 1 )</td>
<td>1-1</td>
</tr>
<tr>
<td>1954</td>
<td>( 2 )</td>
<td></td>
</tr>
<tr>
<td>1955</td>
<td>( 3 )</td>
<td>2-2</td>
</tr>
<tr>
<td>1956</td>
<td>( 4 )</td>
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<tr>
<td>1957</td>
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<td></td>
</tr>
<tr>
<td>1958</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>( 2 )</td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1963</td>
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<td></td>
</tr>
<tr>
<td>1964</td>
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<td></td>
</tr>
<tr>
<td>1965</td>
<td>( 3 )</td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1968</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1969</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>( 4 )</td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1972</td>
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<td></td>
</tr>
<tr>
<td>1973</td>
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<td></td>
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<tr>
<td>1974</td>
<td>( 5 )</td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td></td>
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</tr>
</tbody>
</table>

Legend

- Plots open to grazing
- Plots closed to grazing
C. Plot and subplot treatments

The ground preparation and planting treatments will be pioneered on the cheatgrass site. The most promising of these will be applied on the area in the bunchgrass site.

Thirteen basic treatments are planned in the cheatgrass type, as listed below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Kind</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Disc-drill seed</td>
</tr>
<tr>
<td>2</td>
<td>Disc-drill fruit</td>
</tr>
<tr>
<td>3</td>
<td>Disc-broadcast seed</td>
</tr>
<tr>
<td>4</td>
<td>Disc-broadcast fruit</td>
</tr>
<tr>
<td>5</td>
<td>Burn-drill seed</td>
</tr>
<tr>
<td>6</td>
<td>Spray-drill seed</td>
</tr>
<tr>
<td>7</td>
<td>Burn-broadcast seed</td>
</tr>
<tr>
<td>8</td>
<td>No ground preparation, drill seed</td>
</tr>
<tr>
<td>9</td>
<td>Check plot, no treatment</td>
</tr>
<tr>
<td>10</td>
<td>Drill seed and grass, 6&quot; spacing 2/1</td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

Borders serve this purpose

2.4-D, monuron, chlorophenoxyacetic acid

Crested wheatgrass

Distances from bitterbrush row to nearest grass or nurse shrub row

Treatments 10 to 13 will be carried out on ground prepared by either discing or burning, whichever promises to give the best seedbed and reduction of competing species.

Within each treatment there will be three subplot treatments consisting of variations in ground preparation. In the case of treatment No. 1, for example, the entire plot, consisting of three subplots, will be disced the first year but only subplot one will be seeded the first year. In the second year subplots 2 and 3 will be disced again to reduce competition further and subplot 2 will be seeded. In the third year subplot 3 will be disced again and then seeded.
D. Replications

Each plot and subplot treatment will be replicated once within each season to account for soil variations and repeated for three years to encompass different seasonal growing conditions.

E. Treatment plot design

Each treatment including subplot treatments and three seasonal replications will require an area about 75' wide and 900 feet long. The areal plan and schedule for a disking treatment and burning treatment are shown below.
(1) Treatment plot plan

<table>
<thead>
<tr>
<th>Plot 1</th>
<th>XXXX</th>
<th>Subplot</th>
<th>XXXX</th>
<th>Subplot</th>
<th>XXXX</th>
<th>Subplot</th>
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<tr>
<td>Plot 3</td>
<td>XXXX</td>
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<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
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</tbody>
</table>

- XXXX = equipment turning area
- Usable subplot width = 10'
- Subplot

(2) Disclosed plot

<table>
<thead>
<tr>
<th>Year</th>
<th>Subplot number</th>
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<tr>
<td>1952</td>
<td>1, 2, 3</td>
</tr>
<tr>
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<td>4, 5, 6</td>
</tr>
<tr>
<td>1954</td>
<td>7, 8, 9</td>
</tr>
</tbody>
</table>

1/ Subplot number

Seasonal replication
## Subplot Treatment Schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>Treatment</th>
<th>Disc Subplot No.</th>
<th>Seed Subplot No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>1,2,3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1953</td>
<td>2,3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4,5,6</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1954</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5,6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7,8,9</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>1955</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8,9</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>1956</td>
<td>9</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
Spray 25' band around plot, also equipment turnout lanes with pentachlorophenol when vegetation green and burn for protection of plot from fire.

### Burning Subplot Treatment Schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>Burn</th>
<th>Treatment</th>
<th>Subplot No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>1,4,7</td>
<td>Seed</td>
<td>1</td>
</tr>
<tr>
<td>1953</td>
<td>2,5,8</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4,7</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1954</td>
<td>3,6,9</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>5,8</td>
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<tr>
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<td>7</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>1955</td>
<td>8</td>
<td></td>
<td>8</td>
</tr>
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<td></td>
<td>6,9</td>
<td></td>
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</tr>
<tr>
<td>1956</td>
<td>9</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>
5. **Planting**
   A. Time - August until ground gets too wet or freezes in the fall.
   B. Depth - 1/2 to 1-1/2 inches; the latter in fast drying soils.

6. **Preliminary Work**
   A. Location of sites

   As a guide to locating the experimental sites, prepare reconnaissance vegetation and
   soil type maps covering the deer winter concentration area based on aerial
   photographs and some field work. Also delimit bitterbrush sites and get in-
   formation on the present condition and probable causes of mortality in
   bitterbrush stands. Observe initial reproduction of the thick, where it occurs, and conditions.
   Typical root systems in different soil types are also due to nutrient demands of
   the plant. Do nutrient tests on bitterbrush to determine its requirement
   and analysis of bitterbrush plants at different times of year.

   Examine effects of previous fires and cultivation treatments on reducing
   competing vegetation on sites similar to those used in study. Contact Modoc
   and Shasta National Forests. Test equipment and possible effects of treat-
   ments of plots.

   C. Seed and seedling protection

   Solicit cooperation of California Fish and Game and U. S. Fish and Wild-
   life Service in appraising rodent population and methods of control - rabbits,
   squirrels, mice, kangaroo rats. Also get help from U. S. Bureau of Entomology
   on control of tent caterpillars.

   These measures are necessary, first, to protect experimental plots; and, second, for developing practical measures for application on larger areas.

   D. Planting stock

   (1) Import seed and plants (5 to 15 years old) of the sprouting form of
   bitterbrush found in Idaho and other places in the Great Basin region for
   testing in California.
(2) Collect seed of California species - approximately 500 lbs.
(3) Collect seed of any other promising browse species if time permits.

Following is a partial list of browse species that should be checked for possible study and use on Eastside game ranges. Still others should be sought:

**Name**

- *Acacia greggii*
- *Amelanchier alnifolia*
- *Artemisia tridentata*
- *Atriplex canescens*
  - "confertifolia"
- *Calliandra eriophylla*
- *Ceanothus cuneatus*
  - "integerrimus"
- *Cercis occidentalis*
- *Cercocarpus betuloides*
  - "ledifolius"
- *Chrysothamnus spp.*
- *Cowania mexicana var. stansburiana*
- *Effedra*
- *Eurybia lanata*
- *Fallugia paradoxa*
- *Juniperus occidentalis*
- *Krameria glandulosa*
- *Peraphyllum ramosissimum*
- *Prosopis glandulosa*
- *Prunus emarginata*
- *Prunus subcordata*
- *Purshia tridentata*
- *Quercus spp.*
- *Rosa spp.*
- *Sambucus spp.*

**Olea cuspidata**

*(Baluchistan)*

*India*

7. **Site Measurements**

Set up site factor station on or near sagebrush-juniper-cheatgrass plot.

**Measure**

- **Precipitation**
- **Snow depth**
  - **Daily**
  - **Total pack**
- **Air temperature and humidity**
- **Soil moisture at following depths**
Soil temperature at 1" 
Foxboro thermograph

8. Records

A. Counts and measurements

B. Photographs from permanent hubs with cameras

9. Equipment

A. Pickup

B. Binoculars

C. Hand lens

D. Cameras

10. Personnel and Headquarters

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor</td>
<td>M. W. Talbot</td>
<td>Berkeley</td>
</tr>
<tr>
<td>Project Leader</td>
<td>A. L. Hormay</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot; Asst.</td>
<td>Two full-time</td>
<td>GS-7</td>
</tr>
<tr>
<td>&quot; Asst.</td>
<td>part-time</td>
<td>GS-5</td>
</tr>
</tbody>
</table>
References

1. Hornsey, A. L.

2. Hornsey, A. L.

3. Blaisdell, J. P.

4. Interstate Deer Herd Committee.

-14-
The Secretary of the Interior
Washington, D. C.

Sir:

The State of California by and through the Department of Fish and Game constituting the State Fish and Game Department, and pursuant to the Federal Aid in Wildlife Restoration Act (50 Stat. 917) and to the Rules and Regulations of the Secretary of the Interior made and published thereunder, does hereby submit this statement describing a wildlife investigations project and requests authorized financing thereof. Said project is proposed as a means of promoting efficient management of wildlife resources, and will be executed under the provisions of said Act and said Rules and Regulations.

1. Title of Project: Game Range Restoration

2. Location of Project: Statewide with primary emphasis in the Great Basin Area of California

3. Supervisors: Ben Glading, Chief, and John E. Chattin, Assistant Chief, Department of Fish and Game, Bureau of Game Conservation

4. Agency which will provide technical direction: California Forest and Range Experiment Station

   Project Leaders: M. W. Talbot, Associate Director, California Forest and Range Experiment Station and A. L. Hormay, Range Conservationist, Associate Leader

5. Other Cooperating Agencies: An advisory committee including representatives of the cooperating agencies, the U. S. Fish and Wildlife Service, the U. S. Forest Service, the University of California, U. S. Bureau of Land Management, U. S. Soil Conservation Service, California Wool Growers Association, California Farm Bureau Federation, California Cattlemen's Association and sportsmen's groups, will be invited to advise on plans and procedures, and to inspect the project if desirable. The function of this committee, however, will be advisory only. Final direction of the project will remain entirely in the hands of California Forest and Range Experiment Station.
personnel, as based on the service agreement between the Department of Fish and Game and the California Forest and Range Experiment Station.

6. Perspective: Big game animals, such as deer and antelope, depend heavily on browse species for their existence, especially on winter ranges. On many ranges in the Great Basin Region of California, browse species have been greatly reduced by heavy game and livestock grazing, fire and insect depredation.

On many of these areas, the remaining browse is insufficient for the game population, particularly for Rocky Mountain mule deer and is deteriorating still further because of the factors mentioned above. It is felt that if the browse species are to be re-established in the reasonably near future, artificial restoration measures must be initiated. Without such action it may take fifty years or more to re-establish a desirable browse such as bitterbrush by natural regeneration even with the best management of grazing and protective measures. The results of this study will apply rather specifically to browse ranges in an area of about 29 million acres in California, Oregon and Nevada, and more generally to other areas in the Great Basin Region.

7. Objectives of the Project: Broadly, to find ways of restoring and increasing desirable browse species on game ranges (most of which are also grazed by sheep or cattle) through artificial reseeding and other cultural means. Specifically, the studies will be undertaken to

(a) Determine the desirable species and varieties of browse, native and introduced, that can be grown on various sites.

(b) Determine how to recognize the various sites to which the various species are adapted.

(c) Determine the conditions that are favorable to germination of the seeds and to the vegetative propagation of the species.

(d) Determine how the sites should be prepared for planting.

(e) Determine suitable planting and propagation techniques.

(f) Determine how the seed and seedlings in the first year or two of growth can be protected against rodents, birds, insects, and similar factors to insure seedling establishment.

(g) Formulate, on the basis of these studies, practical recommendations for restoring browse on these ranges for greater game production.

In these studies special attention will be given to bitterbrush (Purshia tridentata), the most important and widespread game browse on the Great Basin ranges.
8. Procedure: The studies will consist of field and laboratory experiments aimed at developing techniques for re-establishing and increasing browse on areas where fires, insects and heavy grazing have virtually destroyed the original stand over large acreages.

The field studies, in part, will consist of (a) Making reconnaissance surveys to determine location of experimental areas; (b) Establishing fenced and unfenced plots on experimental areas for detailed tests. In these tests comparisons will be made of the effectiveness of burning, chemical spraying, and mechanical treatments such as discing for preparing sites for planting, and of broadcasting and drilling for planting seeds. (c) Making systematic observations over wider areas for interpretation of plot results and guidance of further research.

The laboratory experiments, in part, will consist of comparative tests of: (a) Seed germination. (b) Suitability of different soils for growing the different browse species. (c) Growing seedlings for planting. (d) Nutritive values and chemical constituents in the various browse species.

9. Probable duration of this study: Three years to June 30, 1955.

10. Publication of results: Results will be published in the quarterly CALIFORNIA FISH AND GAME, or in some other suitable publication.

11. Estimated total cost of study: $ 60,000.00

Assurance is given that the foregoing information concerning the project herein described is presented to the best ability of the State Fish and Game Department, and all applicable provisions of the State laws have been fully complied with.

Respectfully submitted:

CALIFORNIA DEPARTMENT OF FISH AND GAME

By /s/ Ben Glading
Chief, Bureau of Game Conservation

Approved: Date April 9, 1952

/s/ Paul T. Quick

Approved: Date April 14, 1952

SECRETARY OF THE INTERIOR

By /s/ R. M. Rutherford
Acting Director, Fish and Wildlife Service
The Secretary of the Interior  
Washington, D. C.

Sir:

The State of California by and through the Department of Fish and Game constituting the State Fish and Game Department, and pursuant to the Federal Aid in Wildlife Restoration Act (50 Stat. 917) and to the Rules and Regulations of the Secretary of the Interior made and published thereunder, does hereby submit this statement describing a wildlife investigations project and requests authorized financing thereof. Said project is proposed as a means of promoting efficient management of wildlife resources, and will be executed under the provisions of said Act and said Rules and Regulations.

1. Title of Project: Game Range Restoration

2. Supervisors: Ben Glading, Chief, and John E. Chattin, Assistant Chief, California Department of Fish and Game, Bureau of Game Conservation.

3. Leaders: M. W. Talbot, Associate Director, California Forest and Range Experiment Station and A. L. Hormay, Range Conservationist, Associate Leader.

4. Work Plan:

The following phases of the investigation will be initiated during the period covered by this segment:

a. Field work.

(1) Make reconnaissance surveys to determine location of experimental areas. These areas will probably be located in the Devil's Garden area of Modoc County and/or in the vicinity of Doyle in Lassen County.

(2) Establish experimental plots (fenced and unfenced) in these areas for detailed tests.
(3) Test various methods of preparing sites and methods of planting such sites.

(4) Collect at least 500 pounds of California bitterbrush seeds and also collect, or acquire, seed and plants of the sprouting type of bitterbrush found in Idaho and elsewhere.

(5) Make systematic observations over wider areas for interpretation of plot results.

b. Laboratory and Office Work.

(1) Determination of factors influencing germination and degree to which these factors can be controlled or modified.

(2) Grow seedlings for experimental planting.

(3) Compile and analyze data gathered in the field and laboratory.

5. The work outlined in Paragraph 4 above will be carried out by the California Forest and Range Experiment Station through either a cooperative agreement or a State of California Standard Service Agreement. A conformed copy of this agreement will be submitted when it has been duly executed. It is felt that the most efficient method of operation of the project would be to include all expenses, except for the contingency fund, in the contract. Therefore, the following tabulation indicates the approximate manner in which the contractual budget item is to be broken down.

Salaries

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<thead>
<tr>
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<td>Project Assistants (to be appointed)</td>
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<td>GS-5</td>
<td>$3,785.00</td>
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<td>$4,205.00</td>
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<td>Labor</td>
<td>$3,150.00</td>
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<td>Stenographer (GS-3, half time)</td>
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Total: $11,840.00

Service and expense

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<th>Amount</th>
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Total: $6,130.00
Materials and supplies

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<tr>
<td>Office supplies</td>
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<td>Film</td>
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<td>Telephone and telegraph</td>
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<tr>
<td>Miscellaneous</td>
<td>100.00</td>
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</tbody>
</table>

Total 2,030.00

TOTAL ALL FUNCTIONS 23,000.00

It is thought that it is most efficient to allow the project to purchase its materials and supplies through its own organization rather than to attempt to do so through the Department of Fish and Game. Such purchases will be governed by the applicable Federal rules and regulations with which the project personnel are familiar.

6. Estimated expenditures July 1, 1952 to June 30, 1953:

Service and Expense

Contractual services with the California Forest and Range Experiment Station $23,000.00

Total Service and Expense $23,000.00

TOTAL ALL FUNCTIONS 23,000.00

Contingency 2,000.00

Total $25,000.00

Assurance is given that the foregoing information concerning the project herein described is presented to the best ability of the State Fish and Game Department, and all applicable provisions of the State laws have been fully complied with.

Respectfully submitted:

CALIFORNIA DEPARTMENT OF FISH AND GAME

By /s/ Ben Glading
Chief, Bureau of Game Conservation

Approved: Date May 20, 1952

/s/ Paul T. Quick
Acting Regional Director

Approved: Date June 13, 1952

SECRETARY OF THE INTERIOR

By /s/ Donald J. Chaney
Acting Director, Fish and Wildlife Service
A COOPERATIVE AGREEMENT
BETWEEN THE
U. S. DEPARTMENT OF AGRICULTURE
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
AND
DEPARTMENT OF FISH AND GAME
STATE OF CALIFORNIA

Act of May 22, 1928, c. 678, para. 1, 45 Stat. 699
(16 USC 581) as amended by Act of April 24, 1950

AGREEMENT

THIS AGREEMENT, made this 16th day of June, 1952, by and between the California State Department of Fish and Game, through its duly qualified Director, hereinafter referred to as the "State" and the U. S. Department of Agriculture, California Forest and Range Experiment Station, through its duly qualified Director, hereinafter called "Station":

WITNESSETH

WHEREAS, the Station and the State recognize that big-game animals such as deer and antelope depend heavily on browse species for their existence, especially on winter ranges, and

WHEREAS, it is recognized that on many ranges in the Great Basin Region of California and elsewhere in the State browse species have been greatly reduced by heavy game and livestock grazing, fire and insect depredation, and

WHEREAS, on many of these ranges the remaining browse is insufficient for the big game population, and

WHEREAS, it is agreed that if the browse species are to be re-established in the reasonably near future, artificial restoration measures must be initiated, and

WHEREAS, the Station and State desire to find a method or methods of restoring and increasing desirable browse species on game ranges through artificial reseeding and other cultural means and

WHEREAS, the Station and State are desirous of accomplishing the above aims by means of a written agreement,

NOW, THEREFORE, it is agreed as follows:

A. The Station agrees:

1. To conduct a study of the methods of restoring and increasing desirable browse species on game ranges as follows:

   (a) Determine the desirable species of browse, native and introduced, that can be grown on various sites.
(b) Determine how to recognize the various sites to which the species are adapted.

(c) Determine the conditions that are favorable to germination of the seeds and to the vegetative propagation of the species.

(d) Determine methods of preparing the sites for planting.

(e) Determine suitable planting and propagation techniques.

(f) Determine methods of protecting seed and seedlings from rodent, bird and insect depredations.

(g) Formulate practical recommendations for restoring browse species on these ranges.

2. To hire the qualified personnel, to furnish motor equipment, to purchase expendable materials and supplies necessary to accomplish the objectives specified in Paragraph A-1 above.

3. To furnish the State quarterly, in triplicate, a statement setting forth in detail by position the salaries, travel expenses, number of miles of automobile rental claimed, itemized costs of expendable materials and supplies purchased, itemized costs of miscellaneous services.

4. To furnish the State monthly progress reports on the third of each month and quarterly progress reports on the third of October, 1952 and January, April and July, 1953, and such special reports within 15 days notice as may be requested by the U. S. Fish and Wildlife Service, Division of Federal Aid.

5. Upon completion of the study, within a period not to exceed 60 days, to furnish to the State a final report embodying plans and recommendations for restoring browse species on the ranges studied.

6. To make available for inspection by qualified State and Federal Officers at all reasonable times all books, records and documents which may pertain to studies conducted by the Station under the terms of this agreement.

B. The State agrees:

1. Pursuant to Section 12125 of the Government Code, the State agrees to deposit with the Regional Fiscal Agent, U. S. Forest Service, Appraisers Building, San Francisco 11, California, when called upon by the Forest Service, the sum of Twenty Three Thousand Dollars ($23,000.00) by remittance drawn payable to the Treasurer of the United States. This deposit will be to defray the costs to the Station of the studies undertaken under Paragraph A-1 above. Costs are understood to include salaries and wages, travel expenses, motor equipment use, expendable materials and supplies and miscellaneous services.
The costs of operation of motor equipment furnished by the Station will be computed according to the standard Station equipment rental schedule in force at the time the work is performed.

2. To furnish the Station as may be mutually agreed upon, various items of property and equipment for exclusive use on the study. Said property and equipment will remain the property of the State and at the termination of this agreement shall be returned to the State in as good condition as when received, ordinary wear and tear and Acts of God excepted.

C. It is mutually agreed:

1. The total cost of the study proposed herein shall not exceed $23,000.00 and this agreement shall commence July 1, 1952 and shall remain in effect until June 30, 1953, inclusive.

2. Upon the termination date of this agreement any unobligated balances remaining in the funds deposited by the State for carrying out the studies specified herein will be refunded to the State.

3. That the State and Station shall not be bound to make any expenditure under the terms of this agreement, except as funds are appropriated by the Legislature of the State of California or by the Congress of the United States.

4. That no Member of or Delegate to Congress, or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise therefrom unless it be made with a corporation for its general benefit.

5. That in the performance of this agreement, there shall be no discrimination against any employee or applicant for employment because of race, creed, color or national origin.

6. It is understood and intended that this agreement may be renewed annually subject to such amendments and changes as may be mutually agreed upon by the Station and the State.

STATE OF CALIFORNIA
DEPARTMENT OF FISH AND GAME

By /s/ W. T. SHANNON
Deputy Director

ZES WEB
DEPARTMENT OF FINANCE
APPROVED
June 26, 1952

JAMES S. DEAN, Director

/s/ LOUIS J. HEINZER
Administrative Advisor

UNITED STATES DEPARTMENT OF AGRICULTURE
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

By /s/ STEPHEN N. WYCKOFF
Director
Objectives:

1. Get new personnel on project oriented and equipped for work.

2. Collect 100 to 200 pounds of bitterbrush seed and smaller amounts of seed of other browse species as the opportunity arises.

3. Tentatively select experimental sites on Modoc National Forest, with Modoc and Department of Fish and Game personnel. Experimental requirements of site call for consideration of:
   Vegetative type
   Soil and slope
   Rodents and insects
   Game
   Livestock
   Weather
   Accessibility

Make final selection of site later, with Forest, Fish and Game, Regional Office, and other personnel concerned with the project.

4. Acquaint new Station personnel on project with field conditions, Forest, and other personnel, and the problem generally. Locate field headquarters if possible.

5. Start setting up systematic method of handling, keeping track, and storing seed. Inquire about seed cleaning equipment in Berkeley.

6. Plan future work.
RR
COOPERATION
State of California
Department of Fish and Game

Project WH6R-1

annual usage

GENERAL STUDY PLAN

July 1, 1952 to June 30, 1953

RESTORATION OF BROWSE ON GAME RANGES BY ARTIFICIAL METHODS

I. Introduction

Browse is a major item in the diet of big game animals like deer and antelope. It is especially important on snow-covered winter ranges where often it is the only feed available to the animals. Some browse species are also valuable as cover and afford protection to the animals from predators and the elements. In California, browse has been greatly reduced on many game ranges because of heavy grazing by both game and livestock, and because of fire, insect depredation, and other causes.

The California Forest and Range Experiment Station has undertaken a cooperative State-wide research project with the California Department of Fish and Game, to develop artificial reseeding and other cultural methods of restoring browse on game ranges where the browse has been greatly reduced or eliminated and where natural regeneration is unlikely in the next 50 years. Particular attention at the beginning will be given to restoration of browse on deer winter ranges.

The first studies will be confined to the Great Basin area of the State, locally called the Eastside Region, and limited largely to bitterbrush (Purshia tridentata), the most important and widespread browse on Eastside ranges. Here the critical deer winter ranges lie in an altitudinal zone between 3,600 and 5,500 feet. Precipitation varies from 5 to 15 inches in different localities. The soils are derived from lava and granite and grade from coarse to fine. The Eastside region supports a heavy population of Rocky Mountain mule deer, who depend heavily on bitterbrush, especially on the winter ranges. Bitterbrush is also grazed closely by cattle, sheep, deer and antelope. It is killed in practically all cases by fire. Two or three successive defoliations by tent caterpillars also kill the plant and close grazing interferes with its reproduction. These factors and others acting singly and in combination have eliminated the species on extensive areas and reduced and weakened the stands on others.
The present studies will be undertaken in Modoc and Siskiyou Counties in the heart of the winter range of the Oregon-California Inter-State Deer Herd. Here browse—bitterbrush in particular—has been all but eliminated by deer and livestock grazing, fires, and tent caterpillars. Much of the range is now heavily clothed with cheatgrass.

II. General Scope of Studies and Major Lines of Work

A. Suitable species

   1. Find desirable native and introduced species and varieties of browse that will grow on the range. Consider palatability, yield, growth habit (sprouting or non-sprouting) and ease of collecting and processing seed in initial screening of species. Consider using some species as nurse plants.

   2. Conduct life history studies of the most promising species—paying particular attention to reproduction, seed germination, palatability and nutritional value to game and livestock resistance to grazing, and susceptibility to injury by rodents, insects, diseases and fire.

   3. Determine criteria for judging the sites to which the various species are adapted.

   4. Develop seed collecting and cleaning techniques.

B. Preparation of site for planting

   1. Develop methods for reducing or eliminating the existing undesirable plants from the planting sites by

      a. Mechanical means
      b. Chemical means
      c. Fire
      d. Grazing
      e. Any other

   2. Develop methods of preparing the soil for seeding or planting.

C. Seed and seedling protection

   1. Develop methods of protecting the planted seed and the young seedlings during the period of establishment (first four years) from

      a. Rodents
      b. Insects (tent caterpillars and others)
      c. Birds
      d. Others
C. Prepare and plant some plots within the fenced area to bitterbrush. Experimental plots for this purpose will be about 25 feet wide and 100 feet long. Establish nursery rows of bitterbrush and other species to test species adaptability and variety differences.

D. Test methods of site clearing and seedbed preparation on suitable sites outside the experimental area. Some of the land-clearing or site-preparation treatments will include diskimg, chemical spraying, and burning. Some of the site treatments planned for bitterbrush follow:

<table>
<thead>
<tr>
<th>No.</th>
<th>Plot Treatments</th>
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<tbody>
<tr>
<td>1</td>
<td>Disk-drill seed</td>
</tr>
<tr>
<td>2</td>
<td>Disk-drill fruit</td>
</tr>
<tr>
<td>3</td>
<td>Disk-broadcast seed</td>
</tr>
<tr>
<td>4</td>
<td>Disk-broadcast fruit</td>
</tr>
<tr>
<td>5</td>
<td>Disk-drill seed</td>
</tr>
<tr>
<td>6</td>
<td>Spray-burn-drill seed</td>
</tr>
<tr>
<td>7</td>
<td>Burn-broadcast seed</td>
</tr>
<tr>
<td>8</td>
<td>No ground preparation, drill seed 6&quot; spacing</td>
</tr>
<tr>
<td>9</td>
<td>Drill seed and grass 12&quot; spacing</td>
</tr>
<tr>
<td>10</td>
<td>&quot;          &quot;          &quot;          12&quot;           &quot;</td>
</tr>
<tr>
<td>11</td>
<td>&quot;          &quot;          &quot;          16&quot;           &quot;</td>
</tr>
<tr>
<td>12</td>
<td>&quot;          &quot;          &quot;          nurse shrub 6&quot; spacing</td>
</tr>
</tbody>
</table>

1. General design of treatment plots

   a. Each treatment plot—for example, one that calls for disking and drilling seed—will be divided into three subplots to permit testing how many repeat diskings will give the desired results. For example, in the first year all subplots will be disked but only one seeded. In the second year the unseeded subplots will be redisked and one of these seeded. In the third year the third subplot will be redisked and seeded.

   Each treatment plot will be replicated once within the season to get a measure of site variation and three times over a three-year period to encompass weather variations. Each treatment, including all subplots and replications, will require an area 75 feet wide and 500 feet long. An area of 16 acres under fence will supply sufficient space for several species of plot work and nursery rows.

   Treatment area 13 acres
   Nursery area 3 "
   16 acres

1/ Crested wheatgrass
2/ Distance from bitterbrush row to nearest grass or nurse shrub row
After suitable site preparation and planting techniques are worked out on plots outside the fenced enclosure, they will be tested inside the enclosure where seedling survival can be judged without interference by game, livestock or certain rodents.

E. Obtain a clear idea of the different kinds of deer winter ranges on the east slope of the Sierra Nevada-Cascade ranges and of the problems of restoring browse on them. This will require an inspection of the areas with representatives of the California Department of Fish and Game and perhaps others.

F. Start seed germination studies in the laboratory in Berkeley with species presenting dormancy or other germination problems. Plant seed in the experimental area in boxes protected from rodents and birds for testing germination behavior in the field.

G. Start phenological records of key species on experimental sites.

H. Establish a site factor station in the fenced enclosure for measuring:

1. Precipitation
2. Snow depth
   a. Daily
   b. Total pack
3. Air temperature and humidity
4. Soil moisture at following depths
   1"
   6"
   12"
   18"
   30"
   48"
5. Soil temperature at 1"
   Foxboro thermograph

V. Personnel (California Forest and Range Experiment Station)

M. W. Talbot
A. L. Hormay
R. L. Hubbard
E. O. Pearson
B. L. Kay (temporary)
References

1. Hormay, A. L.


2. Hormay, A. L.


3. Blaisdell, J. P.


4. Interstate Deer Herd Committee


Methods and specifications NO 1

SUBSTANCE STUDY PLAN NO. 1

Subject: Plot Design

<table>
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<th>50'</th>
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<tr>
<td>1954</td>
<td></td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td></td>
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</table>

Equipment turning areas

Subplot detail

A = area surveyed
B = area treated
C = area used for plot measurements
x = wooden stakes for guiding equipment and treatment
o = permanent metal stakes marking corners of plot
area on which measurements will be made

Stakes needed:
Wood - 600 1/4" x 1 1/2" x 15"
    600 1/2" x 1 1/2" x 15"
Metal - 600 angle iron fence posts 5' long with spade
Job Plan No. 2

Period: August 1 to 31, 1952

Objectives:

1. Collect more seed of browse species.

2. Together with all concerned, make final selection of main experimental area on the Modoc National Forest.

3. Locate plot sites around main experimental area on Modoc Forest.

4. Lay out and survey plots.

5. Arrange for plot construction and plot treatments with Modoc Forest.

6. Write specifications and order necessary experimental and construction materials.

7. Plan future work.

\[\text{See revised General Study Plan of 7/23/52, covering the first year of work.}\]
<table>
<thead>
<tr>
<th>SALARIES</th>
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<tr>
<td>M. W. Talbot</td>
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<td>A. L. Hormay, GS-11</td>
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<td>R. L. Hubbard, GS-5 (now GS-4)</td>
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<td>GS-7 (vacant at present; $682 of</td>
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<tr>
<td>the money set up for this</td>
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<td>position ($4205) will be used</td>
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<tr>
<td>by B. L. Kay (GS-4), temporary,</td>
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<td>during the summer)</td>
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<tr>
<td>E. Davidson, GS-4 (about half-time)</td>
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<tr>
<td></td>
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<td>23,000.00</td>
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</table>
PROGRESS REPORT - August 1 to 31, 1952
(See Job Plan No. 2)

Accomplishments

1. Seed of the following species were collected for nursery row trials and germination studies:
   - Ceanothus cuneatus
   - Ceanothus integrerrimus
   - Cercocephalum betuloides
   - Cercocarpus ledifolius
   - Prunus subcordata
   - Prunus demissae
   - Sambucus glauca

2. The general location of the initial plots to be used on the project was established on the Modoc Forest area between Fluke Springs, Mears, and the Canby-Tule Lake highway. This area lies in the juniper-sage type on the edge of the pine belt. It receives from 12 to 14 inches of precipitation and supports a cover consisting principally of big sagebrush (Artemisia tridentata), bitterbrush (Purshia tridentata), rabbitbrush (Chrysothamnus sp.), juniper (Juniperus occidentalis), various perennial bunchgrasses including Idaho fescue (Festuca idahoensis), needlegrasses (Stipa thurberiana, S. occidentalis, S. elmeri), junegrass (Koeleria cristata), bluegrass (Poa sandbergii), squirreltail (Sitanion hystrix), and a light stand of cheatgrass (Bromus tectorum).

   The site slopes very gently to the northwest. The soil is light-textured, well-drained, and ranges from 1 to 3 feet deep.

   An experimental plot and nursery site to be fenced against deer, livestock and rabbits located in this area was approved by representatives of the California Department of Fish and Game and the Forest Service on August 12. The following personnel looked over the area on the ground:

   California Department of Fish and Game

   J. Stokes
   B. Knowles
   R. Bushay
   T. Wright
   A. Hightower
Approximately 10 other unfenced plot sites were located in this general area. These will be used to test site clearing, seedbed preparation and planting techniques.

The general location of a second group of unfenced plots for the same purpose was tentatively located in the area immediately to the south and east of Casuse Mt. in an area receiving 8 to 12 inches of precipitation and now dominated by cheatgrass and mustard.

Both the sagebrush-juniper and cheatgrass sites lie within the main winter range of the Inter-State Deer Herd.

3. The plot site to be fenced (tentatively called the Flume Spring Experimental Area) was surveyed and arrangements made with the Modoc Forest to prepare the site for experimentation. This called for removing some of the juniper trees on the area, putting a firebreak around the site on the fenceline, and clean-cultivating a nursery site and certain plot areas inside the fence.
JOB PLAN NO. 2

Period: September 1 to 30, 1952

Objectives:

1. Write specifications and order nursery experimental and construction materials for the Fluekey Spring Experimental Area.

2. Stake out all experimental plots to be used this fall and next spring in both the sagebrush-juniper and cheatgrass experimental areas.

3. Together with Department of Fish and Game and Forest Service representatives, visit the important winter deer ranges on the east slope of the Sierra Nevada-Cascade ranges to get an idea of the major variations in the browse restoration problem throughout the entire region in which initial research effort is to concentrate.

4. Clean and prepare seed for planting and storage.

5. If time permits, start planting nursery and experimental plots.

// See revised general study plan of 7/21/52, covering the first year of work.
JOB PLAN FOR SEPTEMBER, 1952

Objectives:

1. Write specifications and order nursery experimental and construction materials for the Flukey Spring Experimental Area.

2. Stake out all experimental plots to be used this fall and next spring in both the sagebrush-juniper and cheatgrass experimental areas.

3. Together with Department of Fish and Game and Forest Service representatives, visit the important winter deer ranges on the east slope of the Sierra Nevada-Cascade ranges to get an idea of the major variations in the browse restoration problem throughout the entire region in which initial research effort is to concentrate.

4. Clean and prepare seed for planting and storage.

5. If time permits, start planting nursery and experimental plots.
QUARTERLY PROGRESS REPORT
SURVEYS AND INVESTIGATIONS
as required by
FEDERAL AID IN WILDLIFE RESTORATION ACT

1. Title of Project: Game Range Restoration.

2. Supervisor: Ben Glading, Chief, Bureau of Game Conservation, California Department of Fish and Game.


4. Cooperating Agency: California Forest and Range Experiment Station.

5. Summary report of progress. (This report is not for publication.)

Purpose

The primary purpose of this research project is to develop cultural methods (like artificial reseeding) of restoring game browse and cover species on deer ranges in California. This research involves both field and laboratory experimentation. The initial studies are aimed at restoring desirable browse (particularly bitter brush) on the deer winter ranges on the easterly slopes and adjoining plains of the Sierra Nevada-Cascade mountains in the State.

General accomplishments

The first quarter was spent mainly in planning and organizing the project. During this period (1) technical help was appointed to the project, (2) a general work plan was prepared for the year July 1, 1952 - June 30, 1953, (3) seed was collected of available native browse species, (4) a location for initial field plots and a nursery site was established, and (5) a twelve year old experimental bitter brush plot was remeasured.
Details of accomplishments

Personnel

M. W. Talbot and A. L. Horman of the California Forest and Range Experiment Station are planning and giving direction and supervision to the project. Richard L. Hubbard, a graduate of the School of Natural Resources, University of Michigan, was added to the staff in July. Burgess L. Kay, a senior student in forestry at the University of California, was appointed for the summer and returned to school in September. Bennett C. Pearson, formerly of the Inyo National Forest, was transferred to the project in September on a permanent basis and will report for duty about October 12.

Work Plans

A copy of the general work plan for the fiscal year 1953 is attached.

Seed collection

Seed and fruit of desirable native shrub and tree species were collected in the field by staff members. Some seed and fruit was obtained from other sources as shown in table 1. Collecting seed for experimentation is an important phase of the work. To get even small quantities of seed of certain desirable species and strains will require several years because good seed is not produced every year. Locating the seed producing areas in any given year is also a problem.

This year much of the bitterbrush seed developing above an altitude of about 5,500 feet in Modoc and Lassen Counties was killed by freezing. An average seed crop was produced at lower elevations. Very little seed of several other species including snow brush (Ceanothus velutinus), service berry (Amelanchier alnifolia), and bitter cherry (Prunus emarginata), was produced throughout the area traveled in these counties. Heavy dependence must be placed on interested field-going cooperators for locating and getting even the limited seed needed for plot and laboratory tests.

The seed collected this year was cleaned and stored at 41° F. The cleaning, depending on the species, involved removing leaves, twigs, and other foreign matter from the seed or fruit, removing parts of the fruit like the long fuzzy tails on the mahoganies, extracting seed from the fruit, and separating good seed from bad.
<table>
<thead>
<tr>
<th>Species</th>
<th>Amount</th>
<th>Kind</th>
<th>Collecting Agency</th>
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<tbody>
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<tr>
<td>(Arctostaphylos patula)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>Trace</td>
<td>Fruit</td>
<td>C.F. &amp; R.E.S. cooperator</td>
</tr>
<tr>
<td>Bush chinquapin</td>
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<td>Fruit</td>
<td>Project staff</td>
</tr>
<tr>
<td>(Castanopsis sempervirens)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Four wing saltbush</td>
<td>0.1</td>
<td>Seed</td>
<td>S.C.S. cooperator</td>
</tr>
<tr>
<td>(Atriplex canescens)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shad-scale</td>
<td>Trace</td>
<td>Seed</td>
<td>S.C.S. cooperator</td>
</tr>
<tr>
<td>(Atriplex confertifolia)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wedgeleaf ceanothus</td>
<td>1.2</td>
<td>Seed</td>
<td>Project staff</td>
</tr>
<tr>
<td>(Ceanothus cuneatus)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deer brush</td>
<td>2.2</td>
<td>Seed</td>
<td>Project staff</td>
</tr>
<tr>
<td>(Ceanothus integerrimus)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>0.6</td>
<td>Seed</td>
<td>B.E. &amp; P.Q. cooperator</td>
</tr>
<tr>
<td>Birchleaf mahogany</td>
<td>0.4</td>
<td>Seed</td>
<td>Project staff</td>
</tr>
<tr>
<td>(Cercocarpus betuloides)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>Trace</td>
<td>Seed</td>
<td>C.F. &amp; R.E.S. cooperator</td>
</tr>
<tr>
<td>Curl leaf mahogany</td>
<td>0.3</td>
<td>Seed</td>
<td>Project staff</td>
</tr>
<tr>
<td>(Cercocarpus ledifolius)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western chokecherry</td>
<td>2.4</td>
<td>Fruit</td>
<td>Project staff</td>
</tr>
<tr>
<td>(Prunus demissa)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitter cherry</td>
<td>0.2</td>
<td>Fruit</td>
<td>S.C.S. cooperator</td>
</tr>
<tr>
<td>(Prunus emarginata)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sierra plum</td>
<td>18.0</td>
<td>Fruit</td>
<td>Project staff</td>
</tr>
<tr>
<td>(Prunus subcordata)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitterbrush</td>
<td>45.0</td>
<td>Seed</td>
<td>Project staff</td>
</tr>
<tr>
<td>(Purshia tridentata)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>62.5</td>
<td>Fruit</td>
<td>Project staff</td>
</tr>
<tr>
<td>&quot;</td>
<td>Trace</td>
<td>Fruit</td>
<td>C.F. &amp; R.E.S. cooperator</td>
</tr>
<tr>
<td>Blueberry elder</td>
<td>0.2</td>
<td>Fruit</td>
<td>S.C.S. cooperator</td>
</tr>
<tr>
<td>(Sambucus glauca)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horsebrush</td>
<td>0.1</td>
<td>Fruit</td>
<td>Project staff</td>
</tr>
<tr>
<td>(Tetradyxia canescens)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{1/}\) C.F. & R.E.S. stands for California Forest & Range Experiment Station
S.C.S. " " Soil Conservation Service
B.E. & P.Q. " " Bureau of Entomology & Plant Quarantine
Initial plot location

The first experimental field plot and a nursery site were located in the vicinity of Flukey Springs in Modoc County on the Modoc National Forest. This location was selected because it affords most of the experimental conditions needed for getting information on the basic problems of the entire deer winter-range area which lies generally at altitudes between 3,600 and 5,500 feet and receives from 5 to 15 inches of precipitation.

Regular production of seedlings every year is vital for getting experimental information rapidly. Such seedlings are needed for checking the effectiveness of various land clearing and planting techniques and for studying species adaptability and other problems. These seedlings can be obtained regularly only in the higher precipitation areas.

The Flukey Springs area receives from 12 to 14 inches of precipitation and is about as favorable an experimental site as can be found in the east-side region. Its location was agreed upon by representatives of the Department of Fish and Game, the Modoc National Forest, and the Experiment Station.

The area lies in the sagebrush juniper type on the very edge of the pine timber belt. The vegetation on the site is shown in Table 2.

The important deer browse species that grow in the general locality on comparable sites are:

1. Bitterbrush (Purshia tridentata).
2. Sierra juniper (Juniperus occidentalis).
3. Birchleaf mahogany (Cercocarpus betuloides).
5. Western chokecherry (Prunus demissa).

The area will be fenced against game and livestock. A portion of the area is being cleared of junipers and cultivated for a nursery and for treatment plots. A check series of unfenced plots have been surveyed on sites adjoining the fenced area. These will be used primarily to test land clearing and planting techniques. They will not be fenced against deer or livestock grazing. A portion of the nursery sites and some of the experimental plots will be treated and planted this fall.

Bitterbrush establishment and growth

The Experiment Station has several plots on which phases of browse restoration problems have been studied over a long period of time. One of these, a bitterbrush plot established on the Lassen National Forest in 1934 was reexamined for information on bitterbrush germination and growth. The full significance of measurements obtained on this plot will be reported later. A quick size-up of some of the records, however, points to the need for careful site preparation where bitterbrush is to be planted—particularly reduction of existing plant competition.
Table 2. Vegetation composition and density on the Flukey Springs Experimental Area

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Scientific name</th>
<th>Percent</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brush and tree species</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Big sagebrush</td>
<td>Artemisia tridentata</td>
<td></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Bitterbrush</td>
<td>Purshia tridentata</td>
<td></td>
<td>30 (95% dead)</td>
<td></td>
</tr>
<tr>
<td>Rabbitbrush</td>
<td>Chrysothamnus viscidiflorus</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Sierra juniper</td>
<td>Juniperus occidentalis</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Horsebrush</td>
<td>Tetragnymia canescens</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ponderosa pine</td>
<td>Pinus ponderosa</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td><strong>Forb species</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td>Sisymbrium sp.</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Salsify</td>
<td>Tragopogon porrifolius</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Aster</td>
<td>Aster sp.</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Pussy toes</td>
<td>Antennaria sp.</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Blue flax</td>
<td>Linum lewesi</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Yarrow</td>
<td>Achillea lanulosa</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Autumn willowweed</td>
<td>Epilobium paniculatum</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Tarweed</td>
<td>Hemizonia sp.</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Peavine</td>
<td>Lathyrus sp.</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Wooly mulesear</td>
<td>Wyethia mollis</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Loco weed</td>
<td>Astragalus sp.</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>False dandelion</td>
<td>Agoseris sp.</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Buckwheat</td>
<td>Eriogonum sp.</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td><strong>Grasses and sedges</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheatgrass</td>
<td>Bromus tectorum</td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Idaho fescue</td>
<td>Festuca idahoensis</td>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Squirreltail</td>
<td>Sitanion hystrix</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Junegrass</td>
<td>Koeleria cristata</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Western needlegrass</td>
<td>Stipa occidentalis</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Bluebunch wheatgrass</td>
<td>Agropyron spicatum</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ross sedge</td>
<td>Carex rossii</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Giant rye grass</td>
<td>Elymus condensatus</td>
<td></td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Sandberg's bluegrass</td>
<td>Poa sandbergii</td>
<td></td>
<td>T</td>
<td></td>
</tr>
</tbody>
</table>

Total vegetation density 140
Table 3.-Composition and density of vegetation in the Grass Valley bitterbrush enclosure, Lassen National Forest

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Scientific name</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brush and tree species</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitterbrush</td>
<td>Purshia tridentata</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Big sagebrush</td>
<td>Artemisia tridentata</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Ponderosa pine</td>
<td>Pinus ponderosa</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>(Live limbs within 4 ft. of ground)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rabbit brush</td>
<td>Chrysothamnus viscidiflorus</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Grasses and sedges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idaho fescue</td>
<td>Festuca idahoensis</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Squirrel tail</td>
<td>Sitanion hystrix</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Western needlegrass</td>
<td>Stipa occidentalis</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Sedge</td>
<td>Carex rossii</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Other forbs and grasses</td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Total vegetation density .49

Bitterbrush is a rather slow growing species on most sites. Under heavy competition from other plants it grows still more slowly. Under the competition afforded by the plant cover shown in table 3, bitterbrush plants reached an average diameter and height of about 7 inches in 13 years from the time of germination. Plants under less competition stress on nearby sites reached a height and diameter of 18 inches in a comparable period. Practically all of these plants originated from seeds cached by rodents. Most of the plant crowns were made up of several plants blended into one. The mortality in these clusters in 13 years was 60 percent. Most of the plants died in the first 5 years. At the end of the 5th year 50 percent were dead.

SUBMITTED BY

[Signature]

Project leader

APPROVED BY:

CALIFORNIA DEPARTMENT OF FISH AND GAME

By

Chief, Bureau of Game Conservation

DATE
Objectives:

1. Cultivate and in other ways prepare nursery site and experimental plots for initial planting.

2. Plant nursery and experimental plots.

3. Collect seed of species like sagebrush, juniper and others.

4. Make a general appraisal of site conditions and browse restoration problems on the important deer winter ranges on the east slope of the Sierra-Nevada-Cascade Ranges with Department of Fish and Game representatives. Purpose of trip: To make an appraisal of general aspects of the entire winter-range problem.

1/ See General Study plan of 7-23-52 covering the first year of work.
METHODS AND SPECIFICATIONS

No. 2

Subject: Planting can

1. **Purpose**

   To facilitate getting more accurate records of planted seeds and seedlings, and provide protection to seeds and seedlings from rodents, birds and other animals.

2. **Description**

   A common tin can approximately 6" in diameter, 4" to 8" deep. Top and bottom cut out and sides perforated with 1/4" holes spaced approximately 2" apart to provide for movement of soil moisture and for root development. Lid, where needed, to consist of 7" square piece of 1/4" galvanized hardware cloth. Lid to be tied to can with copper wire or hog rings. Set in soil so about 1 1/2 to 2" of the can extends above ground level.
JOB PLAN NO. 5

Period: November 1 to 30, 1952

Objectives:

1. Treat and plant all remaining experimental plots and the nursery site at Flakley Springs.

2. Establish an exploratory plot setup in two deer winter range locations south of Modoc County — one in the State-owned area near Doyle and one near Bishop. Treat these formidable sites and plant them to game-browse species deemed most likely to grow.

\[ See General Study Plan of 7-21-52 covering the first year of work. \]
LINE OF WORK STUDY PLAN

Species: Seed Germination

(See point II. A. 2. in General Study Plan No. 2)

Two main objectives of these studies are to determine

1. The conditions, moisture, temperature, aeration, etc. under which high germination of seeds or fruits can be obtained.

2. The specific causes of dormancy or delayed germination of the seeds if any exists.

General Procedure

Conduct all initial germination tests in Petri dishes on filter paper using distilled water.

Test the germination behavior of seeds of all of the browse species (except bitterbrush) collected or acquired to date at approximately 51° F, 65° F, 75° F and room temperature. Test a new lot of seeds of each species in this way at monthly intervals from December to April.

Examine seeds of the various species under a microscope. Draw and describe their structure, that is, their shape, size and anatomy. Show the position of the embryo in the seed and the number and character of developing tissues.

This picture of the seed can be very helpful in getting at the causes of dormancy and carrying on seed germination investigations generally.

Crocker lists the following main reasons for dormancy in seeds:

1. Rudimentary embryos that must mature before germination can begin.

2. Complete inhibition of H₂O absorption.

3. Mechanical resistance to the expansion of the embryo and seed contents by enclosing structures.

4. Encasing structures interfering with O₂ absorption by the embryo and perhaps CO₂ elimination from it, resulting in the limitation of the processes dependent upon these.

5. A state of dormancy in the embryo itself or some organ of it, in consequence of which it is unable to grow when naked and supplied with all ordinary germinative conditions.

---

6. Combinations of two or more of these.
7. Assumption of secondary dormancy.

Where indicated from knowledge of the seed

1. Test for absorption of water
2. Scarify seed coat
3. Excise embryos
4. Stratify seeds at 32° F and 410° F
5. Etch or break seed coats with chemicals, bacteria, fungi or enzymes
6. Test effect of high temperatures like burning on seed and germination.
LINE OF WORK STUDY PLAN

Chemical Control of Plants

(See point II. B. 1. A. in General Study Plan No. 2)

The competition afforded by existing vegetation to planted browse must be reduced in most cases in the Eastside Region to insure establishment and proper growth of the browse. The primary purpose of this line study is to determine how chemicals can be used to control such competition.

To do an effective job it will be necessary to know the chemicals -- their composition and general properties, how they act, the species affected by them, the susceptibility of the species to various solutions and concentrations of the chemical at various growth stages, and how the chemicals have been used to date.

Reduction of grasses -- perennial bunchgrasses and cheatgrass -- present very formidable problems on Eastside deer winter ranges.
I believe site preparation defined 1-15-53 in other build should be included here as line of work study plan rather than specific study plan.

E.C.M.
Research Responsibilities and Procedures

Refer to General Study Plan No. 2, dated July 23, 1952, covering the period July 1, 1952 to June 30, 1953.

Division of Responsibility

General planning and direction of the research will be carried out by H. W. Talbot and A. L. Hormay. The guiding points in this research will be set forth in written work plans.

Responsibility for carrying out specific lines of work under general supervision will be divided between B. O. Pearson and K. L. Hubbard as follows:

B. O. Pearson

A. Suitable species

1. Develop seed collecting and cleaning techniques

B. Preparation of site for planting

1. Develop methods for reducing or eliminating the existing undesirable plants from the planting sites by
   a. Mechanical means
   b. Chemical means
   c. Fire
   d. Grazing
   e. Any other

2. Develop methods of preparing the soil for seeding or planting

C. Planting methods

1. Develop suitable seeding and planting procedures
   a. Machinery and other equipment
A. Suitable species

1. Find desirable native and introduced species and varieties of browse that will grow on the range. Consider palatability, yield, growth habit (sprouting or non-sprouting) and ease of collecting and processing seed in initial screening of species. Consider using some species as nurse plants.

2. Conduct life history studies of the most promising species—paying particular attention to reproduction, seed germination, palatability and nutritional value to game and livestock resistance to grazing, and susceptibility to injury by rodents, insects, diseases and fires.

3. Determine criteria for judging the sites to which the various species are adapted.

B. Seed and seedling protection

1. Develop methods of protecting the planted seed and the young seedlings during the period of establishment (first four years) from

   a. Rodents
   b. Insects (tent caterpillars and others)
   c. Birds
   d. Others

C. Planting methods

1. Develop suitable seeding and planting procedures

   a. Species mixtures, rates and spacings of shrubs, grasses and forbs

Procedure

1. Get the objectives of the project and of specific lines of work clearly in mind.

2. Look up and study pertinent published and unpublished information on the various subjects. Abstract all useful information. Suggest placing on 4½ x 6" cards. Prepare card references for all important subjects.

3. Prepare specific work plans for the various studies as they are undertaken.

4. Conduct the studies.

5. Write monthly progress reports on the work. These should include analyses and interpretations of results as they are obtained. They should bring out clearly what was done and call attention to points that loom important. These reports should reflect the trend of thought on the fundamental solution of the various problems. These reports are due one week before the end of each month.
JOB REPORT - November 1 to 30, 1952

1. A series of cans designed to protect seed from disturbance by rodents and birds were installed at the Fluky Springs, Casuse and Milford-Doyle experimental areas and planted with the following species:

(a) Fluky Springs, Modoc County (juniper-sage-cheatgrass type; nursery site-clean cultivated)

<table>
<thead>
<tr>
<th>Plants</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purslia tridentata</td>
<td>Bitterbrush</td>
</tr>
<tr>
<td>Cercocarpus ledifolius</td>
<td>Curl-leaf mahogany</td>
</tr>
<tr>
<td>Cercocarpus betuloides</td>
<td>Birchleaf mahogany</td>
</tr>
<tr>
<td>Arctostaphylius patula</td>
<td>Greenleaf manzanita</td>
</tr>
<tr>
<td>Caryya fremontia</td>
<td>Fremont silktassel</td>
</tr>
<tr>
<td>Atriplex canescens ns</td>
<td>Four-wing saltbush</td>
</tr>
<tr>
<td>Atriplex confertifolia</td>
<td>Shadscale</td>
</tr>
<tr>
<td>Artemisia tridentata</td>
<td>Big sagebrush</td>
</tr>
<tr>
<td>Ceanothus cuneatus</td>
<td>Wedgeleaf ceanothus</td>
</tr>
<tr>
<td>Ceanothus integrerrima</td>
<td>Deerbrush</td>
</tr>
<tr>
<td>Chrysothamnus viscidiflorus</td>
<td>Rabbitbrush</td>
</tr>
<tr>
<td>Eurybia lanata</td>
<td>Winterfat</td>
</tr>
</tbody>
</table>

(b) Casuse Area, Modoc County (cheatgrass-mustard type; clean-cultivated)

<table>
<thead>
<tr>
<th>Plants</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purslia tridentata</td>
<td>Bitterbrush</td>
</tr>
<tr>
<td>Artemisia tridentata</td>
<td>Big sagebrush</td>
</tr>
<tr>
<td>Ceanothus cuneatus</td>
<td>Wedgeleaf ceanothus</td>
</tr>
</tbody>
</table>

(c) Milford-Doyle Area, Lassen County (sagebrush-cheatgrass type)

<table>
<thead>
<tr>
<th>Plants</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purslia tridentata</td>
<td>Bitterbrush</td>
</tr>
<tr>
<td>Artemisia tridentata</td>
<td>Big sagebrush</td>
</tr>
<tr>
<td>Ceanothus cuneatus</td>
<td>Wedgeleaf ceanothus</td>
</tr>
</tbody>
</table>

At this area half of the cans were located on clean-cultivated land and half on undisturbed land.

These can setups were designed to obtain information on the adaptability of various browse species and on the importance of depth of planting. One-half of the cans were covered with 1/4-inch hardware cloth and the remainder were left uncovered in order to determine the extent to which rodents and birds bother the seeds and seedlings.

2. Local Fish and Game personnel on the Milford-Doyle area, under the supervision of Jesse Blaisdell, plowed about half an acre and cleared a firebreak around approximately an acre plot which is to be fenced against deer and livestock.
3. Specifications were drawn up and estimates made for the fencing materials required for the construction of three deer-proof enclosures; one each at the Flinkey Springs, Milford-Doyle and Bishop areas. Bids for this material have been requested.

4. Soil samples were brought into Berkeley from the Flinkey Springs, Casuse and Milford-Doyle areas. These samples are to be used in seed germination studies.
Accomplishments

1. Cans were designed to protect seed from disturbance by rodents and birds. No. 10 cans were used. Both ends were cut out and the sides were perforated with approximately 40 holes to allow free passage of water and roots. One-half of the cans were covered with 1/4-inch hardware cloth which was fastened to the cans with hog ringers. The cans were sunk in the ground with approximately 2 inches protruding. Five spots of 5 seeds each (in the case of most species) were planted in each can. These spots varied in depth of planting from 0 inches to an arbitrary maximum which varied with the individual species according to size. The 5 plantings are expected to give information on the adaptability of species to certain sites and the importance of depth of planting. There are several factors which might affect the results obtained by this technique.

(a) Shade and protection afforded by the hardware cloth covering.

(b) The protection afforded individual seed spots due to their position within the can.

(c) Whether the cans actually will permit free passage of water and roots through the holes.

2. These cans were planted on a clean, cultivated site with the exception of the Doyle area where half were planted on a clear, cultivated site and half on undisturbed land. Species planted in the above-mentioned 21 cans in the various areas are as follows:

(a) Flume springs (Nursery site)

Purshia tridentata
Cercocarpus ledifolius
Cercocarpus betuloides
Aristotheleus patula
Garrya fremontii
Atriplex canescens
Atriplex confertifolia
Artemisia tridentata
Geanothus cuneatus
Geanothus integrinmus
Chrysothamnus v iscidiflorus
Eutectia lanata
Juniperus occidentalis
Prunus demissa
Salix glauca
Maliloutus alba

Bitterbrush
Curl-leaf mahogany
Birchleaf mahogany
Greenleaf manzanita
Fremont silktassel
Four-wing saltbush
Shad-scale
Big sagebrush
Wedgeleaf ceanothus
Deerbrush
Rabbitbrush
Winterfat
Western juniper
Western chokecherry
Blueberry elder
White sweetclover
(b) Outside Flukey Springs

Purshia tridentata
Cercocarpus ledifolius
Carya fremontia
Artemisia tridentata
Ceanothus cuneatus
Chrysothamnus viscidiflorus
Melilotus alba

Ritterbrush
Curl-leaf mahogany
Fremont siltlassel
Big sagebrush
Wedgeleaf ceanothus
Rabbitbrush
White sweetclover

(c) Casuse Area

Purshia tridentata
Ceanothus cuneatus
Artemisia tridentata

Ritterbrush
Wedgeleaf ceanothus
Big sagebrush

(d) Milford-Doyle Area

Purshia tridentata
Artemisia tridentata
Ceanothus cuneatus

Ritterbrush
Big sagebrush
Wedgeleaf ceanothus

3. Local Fish and Game personnel on the Milford-Doyle area, under the supervision of James Elaisdell, plowed and prepared a half-acre plot on the Doyle area and constructed a firebreak around the area.

4. Specifications were drawn up and estimates made for the fencing materials. Bids have been requested.

5. Soil samples were taken at Flukey Springs, Casuse, and Doyle. The soil profile at these areas was examined.
Objectives:

1. Initiate laboratory and greenhouse seed germination studies with the more important deer browse species.

2. Plant selected browse species on the exploratory plot near Bishop, on Bureau of Land Management land.

3. Start organizing and summarizing field information obtained to date. Start rounding up and digesting existing published and unpublished information bearing on the project.

\[\text{See General Study Plan of 7-23-52 covering the first year of work.}\]
Accomplishments

1. Available information pertaining to germination and seed treatment covering the browse species being considered for game range restoration was summarized (Table 1).

2. Inyo Forest personnel plowed about half an acre and cleared a firebreak around approximately an acre plot in Wells Meadow near Bishop. This area is to be fenced against deer and livestock.

3. A series of cans designed to protect seed from disturbance by rodents and birds was installed at Wells Meadow. The following species were planted in these cans.

   - Artemisia tridentata (Big sagebrush)
   - Atriplex canescens (Four-wing saltbush)
   - Atriplex confertifolia (Spiny saltbush)
   - Ceanothus greggii (Gregg ceanothus)
   - Purshia tridentata (Bitterbrush)

The predominant existing vegetation on this area is big sagebrush and Mormon tea. Del Fausett seemed to think that fire and nature would provide as good a stand of Mormon tea as could be desired.

4. Fred L. Jones, Assistant Game Manager, California Fish and Game, was contacted in an effort to determine what information concerning browse utilization and preference by deer on the winter deer range was available. Fred has 2 years' data on utilization for the Elderberry unit which lies about a mile south of our experimental area.

   The three browse species which Fred felt should be considered for the Inyo area are: bitterbrush, Ceanothus greggii, and Eriogonum fasciculatum.
Table 1.--Germination Data for Species Used on Game Browse Project

(Taken from l89 file CP&RES and Forest Research Notes No. 21)

<table>
<thead>
<tr>
<th>Species</th>
<th>Days to Germinate</th>
<th>Highest % Germination</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arctostaphylos patula</td>
<td>90</td>
<td>1-2</td>
<td>Oxalic acid, peat moss</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>0</td>
<td>Citric acid, peat moss</td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>6</td>
<td>1 hour con. sulphuric acid, sand</td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>0</td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>7</td>
<td>4-year-old seed, strat. 5 mos.</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>0</td>
<td>1 hour con. sulphuric acid, cold storage 75 days</td>
</tr>
<tr>
<td>Atriplex canescens</td>
<td>90</td>
<td>16</td>
<td>18 hrs. sulphuric acid, 3 mos. soil - peat</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>14</td>
<td>No treat. 60% reported germ. green seed pref. to dry</td>
</tr>
<tr>
<td>Ceanothus cuneatus</td>
<td>90</td>
<td>1</td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>12</td>
<td>Stored 24 days at 400 C.</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>39</td>
<td>Soaked overnight in hot water</td>
</tr>
<tr>
<td>(Quick's)</td>
<td>105</td>
<td>56</td>
<td>Untreated seed 40% - germination doubled by scalding dry seed with boiling water. Seedlings damp-off easily rec. water in mom.</td>
</tr>
<tr>
<td>Ceanothus</td>
<td>90</td>
<td>85</td>
<td>Hot water treat. with subsequent strat. for 3 mos.</td>
</tr>
<tr>
<td>integerrimus</td>
<td>98</td>
<td>0</td>
<td>Soil and peat</td>
</tr>
<tr>
<td></td>
<td>138</td>
<td>71</td>
<td>40° F. for 90 days</td>
</tr>
<tr>
<td>(Quick's)</td>
<td>105</td>
<td>85</td>
<td>80° C. water treat. 3 mos. at 25° C.</td>
</tr>
<tr>
<td>Cercocarpus betuloides</td>
<td>25</td>
<td>34</td>
<td>Soil</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>21</td>
<td>Strat. 3 mos. at 5° C.</td>
</tr>
<tr>
<td></td>
<td>57</td>
<td>76</td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>76</td>
<td>Storage 1 year - soil</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>72</td>
<td>Soil</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>89</td>
<td>Storage 1 year - soil</td>
</tr>
<tr>
<td>Cercocarpus ledifolius</td>
<td>90</td>
<td>35</td>
<td>Soil</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>0</td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>263</td>
<td>44</td>
<td>Soil</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>1</td>
<td>90 days at 5° C.</td>
</tr>
<tr>
<td></td>
<td>116</td>
<td>2</td>
<td>Soil</td>
</tr>
<tr>
<td>Chrysothamnus nauseos</td>
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<td>Sand</td>
</tr>
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<td></td>
<td>104</td>
<td>36</td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>4</td>
<td>Soil</td>
</tr>
<tr>
<td>Garrya fremonti</td>
<td>162</td>
<td>4</td>
<td>18 hours 1.5% KOH - soil</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>1</td>
<td>3 mos. at 5° C.</td>
</tr>
<tr>
<td></td>
<td>117</td>
<td>0</td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>24</td>
<td>98 days at 5° C. soil, peat</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>68</td>
<td>3 mos. at 5° C. soil</td>
</tr>
<tr>
<td>Juniperus californica</td>
<td>57</td>
<td>0</td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>0</td>
<td>5 mos. at 0° C. peat moss</td>
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<tr>
<td>Juniperus scopularum</td>
<td>30</td>
<td>0</td>
<td>3 mos. at 5° C. soil</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>0</td>
<td>Soil</td>
</tr>
<tr>
<td>Species</td>
<td>Days to Germinate</td>
<td>Highest % Germination</td>
<td>Treatment</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
<td>------------------------------------------------</td>
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<tr>
<td>Prunus demissa</td>
<td>15</td>
<td>4</td>
<td>36°F. for 2 mos.</td>
</tr>
<tr>
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<td>87</td>
<td>12</td>
<td>50°C. for 3 mos, sand</td>
</tr>
<tr>
<td>Prunus emarginata</td>
<td>49</td>
<td>0</td>
<td>Soil, sand</td>
</tr>
<tr>
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<td>268</td>
<td>4</td>
<td>Soil</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td>0</td>
<td>Soil ?</td>
</tr>
<tr>
<td>Sambucus glauca</td>
<td>90</td>
<td>17</td>
<td>Fresh seeds</td>
</tr>
<tr>
<td>White clover</td>
<td>9</td>
<td>64</td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>71</td>
<td>Sand</td>
</tr>
</tbody>
</table>