RR
COOPERATION
State of California
Department of Fish and Game

CF&RES
January 5, 1953

Project W46R1

JOB PLAN NO. 7 1/

Period: January 1 - 31, 1953

Objectives:

1. Prepare plans for and initiate seed germination studies.

2. Find chemicals that can be used to destroy or reduce the various competing plant species found on Eastside deer winter ranges where browse revegetation is needed.

3. Organize and summarize data collected to date.

1/ See General Study Plan of 7-23-52 covering the first year of work.

Fish & Game
BOP, RLH

PHH ED File in my book

RR
COOPERATION
State of California
Dept. of Fish and Game
Project W-6R1

A.L.H.
1-15-53

~~Specific~~ study

~~GENERAL~~ PLAN

Subject → Preparation of Site ~~for Planting~~ (See II B, page 2, of July 23, 1952, General Study Plan)

~~General statement~~

The ultimate objective of this line of work is to find ways of reducing the existing plant cover on the planting site to a level that will allow a satisfactory stand of planted species to become established on the site. This probably means that plant competition will have to be reduced and held at a low level for at least two growing seasons -- and perhaps longer -- because quick recovery of native plant density on the site would provide heavy competition to planted species. Furthermore, it appears that there will be little opportunity for reducing or altering the density of the plant cover appreciably after planting. This means that the effect of treatments applied to reduce plant competition must carry through two or more seasons after the treatments are applied and plantings are made.

Various means are available for changing the plant cover. Some of these are listed under point II B. These factors can be combined in many ways. Initial clearing in most cases in the Eastside region probably will be with fire. This may be followed by repeat burning or by the application of other measures.

Proper timing and combinations of treatments are important. Satisfactory results depend on a clear understanding of the effect of each treatment on the vegetation and on proper application of the treatment to fit the case. The latter comes largely with experience.

The first effort in this line of research will be aimed at finding chemicals suitable for controlling the principal plant species found on Eastside deer winter ranges. Some of these are: cheatgrass, sagebrush, perennial bunchgrasses, and others. The chemical composition of these herbicides and their known effect on different species should be thoroughly understood. The more promising should be tested on Eastside vegetation -- on the cover as a whole and on each species.

Burning studies should be carried out at the same time and probably in combination with the chemical studies.

Whether a given intensity of plant control is satisfactory or not can be judged only in terms of the responses of the planted species. In general, then, it will be necessary to plant the species to be used ultimately on the site and note the growth and survival of the species at various levels of plant cover reduction.

copies to BOP, RLH, file

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W-6R-1

CF&RES
January 30, 1953

JOB PLAN NO. 8 1/

Period: February 1 - 28, 1953

Objectives:

1. Continue seed germination studies.

2. Continue to gather information on land clearing techniques.

3. Install soil moisture recording elements on the Flukey Spring, Doyle, and Wells Meadow experimental areas.

1/ See General Study Plan of 7-23-52 covering the first year of work.

c to Fish & Game
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RAH
file

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Dept. of Fish and Game
Project W-6R-1

2-2-53
A.L.H.

Outline

Job Plan - February

Hubbard (Pearson)

1. Start stratifying bitterbrush seed for spring planting.
   4 lbs. at 32° F. with bubbling air.

2. Count on spring planting all shrub species showing quick germination of seeds or fruits. (March or April - hand plant all species in can setups. Also, drill stratified bitterbrush seed at Camas Mt. and Flukey Spring on clean cultivated soil.)

3. Install soil moisture elements and terminal stands at Wells Meadow, Doyle, and Flukey Spring experimental areas. Setups probably can be fabricated in Berkeley. Element settings: 1" 3" 6" 12" 24" 36" 48" 60"

4. Prepare a second form for recording germination responses in bitterbrush seed planted in soil - January. This form filled out is to be sent to Berkeley from the field each week.

   Essential information needed:
   - Date of planting
   - Date of observation
   - Place
   - Recorder
   - Germination response - growth
   - Amount of snow on soil surface
     - Depth inches
   - Moisture condition of soil at seed level at time of record
     - Dry (too dry for growth)
     - Damp (growth possible)
     - Moist (ideal for growth)
     - Wet (saturated)
   - Soil frozen, unfrozen
   - Comments

Pearson (Hubbard)

1. Size-up of chemicals and plans for testing effectiveness on species:
   - Formulation
   - Rate
   - Method
   - Species

c.c. to BOP
RLH
file

Location
Approximate time of application
2,4-D Cornelius formulation
Spray in burn (Mears)

2. Mechanical clearing
Bromus tectorum at Casuse Mt.
Grasses, forbs (Flukey)

3. Fire in spring - desiccators

4. Propose sequence of treatments to clear certain types of cover.
(Experimental plans for testing)
Location of work

RLH

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : A. L. HORMAY

DATE: February 10, 1953

FROM : B. O. PEARSON - R. L. HUBBARD

SUBJECT: RR, COOPERATION, State of California, Dept. of Fish and Game, Project W46R-1

Specific study plan (Proposed)
Planting methods

Subject Chemical Fertilizer ~~Studies on Game Browse Project~~

A. Why

1. To determine what chemicals are needed for adequate seedbed preparation.

2. Give bitterbrush a shot in the arm for an initial growth start.

3. Obtain higher forage value for deer.

B. When and Where

1. During Fall planting or seedbed preparation on field study plot.

2. Pot test--standard technique as used by Dr. J. Vlamis.

C. How

1. Pot test--standard technique as used by Dr. J. Vlamis.

2. Five plots 16½ ft. x 33 ft. in triplicate testing N P K in equivalents of 100 lbs. per acre.

$N_0 P_0 K_0$	$N_2 P_3 K_1$	$N_0 P_3 K_1$	$N_2 P_0 K_1$	$N_2 P_3 K_0$

c. to BOP
RLH
file

RR
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1

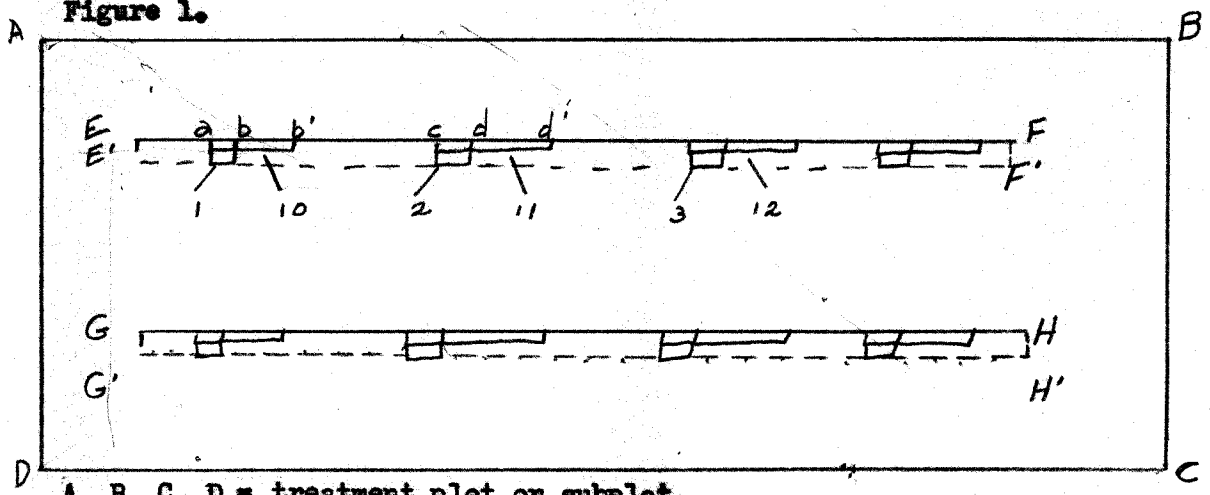
2-19-53
A.L.H.

METHODS AND SPECIFICATIONS No 4

Measuring Vegetation Changes on Treated Plots 1/

Basic design of plot and quadrat setup.

Figure 1.



A, B, C, D = treatment plot or subplot
E, F, & G, H = line transects 2 chains long
E, F, F' E' and G, H, H' G' = belt transects
2 chains long, 20 inches wide (0.005 acres)
1, 2, 3 etc. = quadrats 20" square (1/16 milacre)
10, 11, 12 etc. = quadrats 6.27 inches wide
100 inches long (0.0001 acres)

The number of plots, transects within plots, and quadrats along transects used in a given case depends on the vegetation and treatment. In general, the number of these units used will be as follows:

Plots or subplots 1 or 2 (in representative areas)
Transect 2 or 3 per plot
Quadrats 20 or more per plot or 10 or more per transect

Also, in general, established shrubs will be measured on belt transects and forbs, grasses, and shrub seedlings on quadrats. A shrub seedling is arbitrarily defined as a plant with a crown diameter of 4 inches or less.

1/ Treatments include chemical spraying, burning, cultivation, planting, etc.

c. to BOD, RLH, files

Marking the corners of plots and quadrats:

Type of corner (See Fig. 1)	Type of marker
A, B, C, D	7' steel fence post painted orange
E, F, and G H	7' steel fence post painted aluminum; head end orange tipped 1 foot
a, b, b' and c, d, d'	1' reinforcing steel rods painted orange on top

Method of designating plots and quadrats:

General Experimental Area, for example, Flukey Spring

Plot No. 1, 2, 3, etc.

Subplot A, B, C, D, etc.

Transect No. 1, 2, etc.

Quadrat No. 1, 2, 3 starting from the head end of the transect

In a particular case either square or oblong quadrats or both may be used. If both, two stakes -- one at a and the other at b' -- will be sufficient to locate and re-establish both quadrats. Point a will be common to both quadrats and point b' will mark the end point of the oblong quadrat. This point provides line orientation permitting establishment of point b for the square quadrat by measurement.

Measurements for general classes of vegetation:

Shrubs

Type of measurement unit = belt transect

Record all plants (except seedlings; see definition page 1) rooting on belt transect.[2/] Number each plant starting at head end of transect. For each plant record:

Species _____
Height (inches) _____
Diameter (inches) _____
Crown form, hedged _____, clubbed _____, normal _____
Percent dead _____

Perennial grasses and forbs and brush seedlings

Type of measurement unit = oblong quadrat

Record all plants (except grass and forb seedlings, plants 1 square inch in basal area or smaller) rooting on quadrat.

2/ The plants root on transect when 50 percent or more of the stem cross section at ground level lies inside the transect.

Number each plant starting at head end of each quadrat. Number plants on each quadrat separately starting each time with number 1.

For each plant record:

Species _____
Diameter at root crown (inches) _____
Percent dead _____

Make general comments on seedling in above terms for each transect.

Annual grasses and forbs

Type of measurement unit = square quadrat

On each quadrat estimate total vegetation density (all vegetation except established shrubs).

Estimate percent composition of this total vegetation as follows:

Perennial grasses and forbs and brush seedlings _____
Annual grasses and forbs _____

Species
1 _____
2 _____
3 _____

CF&RES-219
(2-20-53)

PHENOLOGY

Plant Stages	
No.	Description
1	Start of growth
2	Leaves only
3	Stems showing and surpassing leaves
4	Flowering (peak anthers showing)
5	Seeds ripening (peak milk)
6	Seeds ripe and falling (seed hard)

Project
Locality
Plot No.
Year

Examination No.:
Observer:
Month and Day:

Species Record

Ht. stems-twigs (in.)
Ht. leaves (in.)
% dry
Stage No.
Stage description
Date max. stage

Ht. stems-twigs (in.)
Ht. leaves (in.)
% dry
Stage No.
Stage description
Date max. stage

Ht. stems-twigs (in.)
Ht. leaves (in.)
% dry
Stage No.
Stage description
Date max. stage

Ht. stems-twigs (in.)
Ht. leaves (in.)
% dry
Stage No.
Stage description
Date max. stage

RR
COOPERATION
State of California
Dept. of Fish and Game
Project W-6R-1

2-19-53
A.L.H.

METHODS AND SPECIFICATIONS No 3

Phenology Records

Mark three plants of each perennial species on which records are desired with wooden stakes. Base form write-up on average of these three plants.

Photograph only one plant. Repeat photo this plant until there is need to switch over to one of the other three; for example, if the first plant dies or exhibits unrepresentative growth. Stake a new first (No. 1) plant and consider in write-up.

If not already done, stake general area (an acre or less in size) on which observations and measurements are made. Within this area stake spots (approximately 1/4 milacre in size) on which annuals are observed. (See Phenology Form CF&RES-219).

BOP
R.H.
file

RR
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1

R. L. Hubbard
2-23-53

JOB REPORT - February 1 to 28, 1953

Accomplishments

1. Prepared summary of seed germination studies.

2. Drew up specifications for various items of equipment needed.

3. Worked on various plans for spring plot treatments.

4. Studied available information on Colman soil moisture meter and made plans for the installation of four "stacks" in March. One stack is to be located at Wells Meadow, one at Doyle, and two at Flukey Spring.

c. to BOP
RAH
file

RH

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W-6R-1

CF&RES
February 26, 1953

JOB PLAN NO. 9 1/

Period: March 1 - 31, 1953

Objectives:

1. Install soil moisture recording elements on the Flukey Spring, Doyle, and Wells Meadow experimental areas.

2. Locate and lay out plots for chemical spray work and start spraying.

3. Make spring plantings of bitterbrush and other shrub species studied that germinate readily, on experimental areas where soil moisture is favorable.

4. Initiate phenological records on experimental areas.

5. Start examining experimental plots sown or treated last fall.

1/ See General Study Plan of 7-23-52 covering the first year of work.

cc to Fish & Game
BOP
RH

RR
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State of California
Dept. of Fish and Game
Project W46R-1

B. O. Pearson
2-27-53

JOB REPORT - February 1 to 28, 1953

Accomplishments

1. Gathered information concerning various herbicides -- their application, formulation, and potential results.

2. Ordered equipment and chemicals.

3. Tentative plans call for use of 8 chemicals, 90 plotstudies, on a total of 9 acres. In addition, six 1-acre burn plots are planned in conjunction with the chemical studies.

4. The desirability of carrying out the total chemical program with additional manpower or reducing plot work to present manpower is under consideration.

c. 40 BOP
RAH
file

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1
Game-Range Restoration

CF&RES
A. L. Hormay
3-4-53

ORGANIZATION PLAN NO. 2

Subject: Correspondence and work-file designations and forms of plans and reports

Adherence to the following forms will systematize, clarify, and facilitate the research program.

I. File Designation and Headings

A. Correspondence

1. All organizations outside the Forest Service. Form: Letter

Example:

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1 (Date)
Game-Range Restoration

Mr. John Doe
112 Main Street
Sacramento, California

Dear Mr. Doe:

. . . . . .

2. Branches and offices within the Forest Service but outside the Station. Form: Memorandum (Standard Form No. 64)

Example:

TO: FOREST SUPERVISOR, Lassen (Date)

FROM: STEPHEN N. WYCKOFF, Director, By

SUBJECT: RR, COOPERATION, State of California, Dept. of Fish and Game, Project W46R-1 Game-Range Restoration

c. to BOP, RAH

3. Within Station. Form: Memorandum (Standard Form No. 64)
Subject: RR, GAME BROWSE, followed by subject-matter heading.
(See page 7 for subject-matter heading)

Example

TO: B. O. PEARSON (Date)

FROM: A. L. HORMAY

SUBJECT: RR, GAME BROWSE
Species - seed germination

B. Plans

Kinds

1. General work plan
2. General organization plan
3. Annual work plan
4. Study plan
5. Job plan
6. Proposed plan
7. Organization plan

1. General work plan

Example:

RR-CAL
COOPERATION
State of California CF&RES
Dept. of Fish and Game Name
Project W-6R-1 Date
Game-Range Restoration

GENERAL WORK PLAN

Subject: Restoration of browse on game ranges
by artificial methods

Note: There will be only one General Work Plan but it will be revised periodically as needed.

2. General organization plan

Example:

RR-CAL
COOPERATION
State of California CF&RES
Dept. of Fish and Game Name
Project W-6R-1 Date
Game-Range Restoration

GENERAL ORGANIZATION PLAN

Note: There will be only one General Organization Plan but it will be revised periodically as needed.

3. Annual work plan

Example:

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1
Game-Range Restoration

CF&RES
Name
Date

ANNUAL WORK PLAN
(Year)

Subject: Restoration of browse on game ranges by artificial methods

4. Study plan

Example:

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1
Game-Range Restoration

CF&RES
Name
Date

STUDY PLAN

Subject: One of the five main subjects shown on page 7 followed by subheadings as needed. For example:

Species - seed germination
Planting methods - airplane
Site preparation - chemicals
Site factors - soil moisture
General

5. Job plan (worker to project leader)
(a)

Example:

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1
Game-Range Restoration

Name
Date

JOB PLAN (name of worker)
(Period)

Subject: Usually more than one subject treated. Use headings from page 7.

5. Job plan (Station to Department of Fish and Game)
(b)

Example:

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1
Game-Range Restoration

CF&RES
Date

JOB PLAN (Station to Dept. of Fish and Game) 1/
(Period)

1/ Designation in parentheses to be included on Station work draft only, not on final draft to Department of Fish and Game.

6. Proposed plan

(From workers to project leader).
Use memorandum form.
Add word proposed in parentheses following subject-matter heading.

Example:

TO: A. L. HORMAY (Date)

FROM: B. O. PEARSON

SUBJECT: RR, GAME BROWSE
Study plan (proposed)
Planting methods - airplane

C. Reports

Kinds

1. Publications
   - Bulletin
   - Circular
   - Leaflet
   - Article
   - Research Note
2. Annual report
3. Quarterly report
4. Monthly report
   (a) By workers to project leader
   (b) By Station to Department of Fish and Game; includes monthly job plan
5. Study progress report

1. Publications

Example:

Left for future consideration

2. Annual progress report

Example:

Left for future consideration

3. Quarterly Report

Example:

STATE California

PROJECT NO. W46R-1

DATE

QUARTERLY PROGRESS REPORT

SURVEYS AND INVESTIGATIONS

as required by

FEDERAL AID IN WILDLIFE RESTORATION ACT

1. Title of Project: Game Range Restoration

4. Monthly report

(a) Worker to project leader

Example:

RR
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1
Game-Range Restoration (Date)

PROGRESS REPORT - (Name of worker)
(Period)

Accomplishments

(b) Station to Department of Fish and Game

Example:

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W46R-1 CF&RES
Game-Range Restoration Date

PROGRESS REPORT (Station to Dept. of Fish and Game)[1/]
(Period)

Accomplishments

1/ Designation in parentheses to be included on Station work draft only, not on final draft to Dept. of Fish and Game.

5. Study progress report

Example:

RR-CAL
COOPERATION
State of California
Dept. of Fish andGame — CF&RES
Project W46R-1 — Name
Game-Range Restoration — Date

STUDY PROGRESS REPORT

Subject: One of the five main subjects shown on page 7 followed by sub-headings as needed. For example:

Species - seed germination
Planting methods - airplane
Site preparation - chemicals
Site factors - soil moisture
General

1. Background

Refer to Annual Work Plan and Study Plan

Field work by: (Names)
Compilation by: (Names)
Analysis by: (Names or remark)

B. Methods and specifications

Example:

RR
COOPERATION
State of California — CF&RES
Dept. of Fish and Game — Name
Project W46R-1 — Date
Game-Range Restoration

METHODS AND SPECIFICATIONS

No. ____

Subject: As needed; for example.

Plot design
Quadrats and transects (Browse)
Quadrats and transects (annual grasses, weeds)
Planting can
Livestock-deer exclosure

II. Subject-matter Breakdown

For plans and progress reports

Heading	Scope of heading
A. Species	
Stock	(seed and vegetative) description, variety, habit, source, date, method of collecting, handling, storage, treatments
Germination	(growth through cotyledon stage) factors affecting, causes of dormancy if any, method of treating
Establishment	(growth from cotyledon stage to 3 or 4 years of age) growth, survival, mortality
Growth and reproduction	habit, phenology
Site adaptability	known facts, new facts from study
Forage yield	
Range value	browse, game cover palatability, nutrition, erosion
B. Site factors	
Weather	precipitation (rain gage) temperature (air, soil) evaporation
Soil character	physical characteristics, type, etc. fertility, nutrient deficiencies
Soil fertilization	
Soil moisture	
Diseases and pests	rusts, fungi insects, rodents, birds
Fire	(general effect — not controlled experimental burning)
Grazing	game, livestock

Heading	Scope of heading
C. Site preparation and maintenance	
Mechanical)	
Chemical)	
Fire)	equipment, procedure, time
Grazing)	
Biological	insects, fungi, etc.
D. Planting methods	
Time	of year and with respect to soil moisture and weather
Depth	
Rate of sowing	
Species composition	
Equipment	
E. General	use when several of the above subjects (A, B, C, D and sub-headings) are involved

Other general headings used in plans and reports.

Organization	personnel, job responsibilities, form of plans, reports, files
Surveys	experimental area and plot locations, problem size-up
Experimental areas and plots	location, character, purpose
Methods and specifications	plots, quadrats, measurement and treatment/ procedures
Cooperation	any phase of the work in any form
Publicity and Extension	

III. General Form of Body of Plans and Reports Beyond File Designations and Headings

A. Plans

Suggested headings

1. Background
2. Object or purpose of work and relation to whole problem
3. Location and date of work
4. Conditions
5. Methods, materials, and treatments
6. Remarks

B. Reports

Suggested headings

1. Background
   (a) The problem
       Location
       Conditions
   (b) Object of work
   (c) Location and date of work
   (d) Conditions
       Vegetation
       Soil
       Weather
   (e) Methods and materials

2. Results

3. Analysis and interpretation of results

4. Recommendations

Use headings (or comparable ones) as needed.

In study plans and study progress reports, particularly, refer to information already covered in other study plans and reports to avoid unnecessary repetition of subject matter.

IV. General Information Needed on Maps, Diagrams, and Charts

1. Title or subject
   (a) Location and scale (if applicable)
   (b) Date (if applicable)
2. CF&RES - Berkeley, California
3. Project title or number
4. Date (of preparation)
5. Name (prepared by)
6. Any other pertinent information

RR-CAL
COOPERATION
State of California
Dept. of Fish and Game
Project W-6R-1
Game-Range Restoration

CF&RES
A. L. Hormay
March 13, 1953

STUDY PROGRESS REPORT

Subject: ~~Species~~, ~~[redacted]~~, Planting Method — depth

1. Background

See Annual Work Plan, 1952.

Field work by B. O. Pearson and R. L. Hubbard
Compilation by R. L. Hubbard and B. O. Pearson
Analysis by (no analysis involved)

Object of work

To get preliminary information on species germination and adaptability to site and time and depth of planting.

Location and date of work

Flukey Spring, Casuse Mt., Doyle and Wells Meadow experimental areas. November and December 1952.

Nature of work

Seeds of various species of shrubs were planted on different sites under different conditions of plant cover and different conditions of protection from grazing and similar factors. These plantings were made in standard cans (see M&S No.).

2. Work by Experimental Areas and Plots

A. Flukey Spring (sagebrush-juniper type)

Plot No. 8 (protected--fenced against livestock and deer; see map for location).

Size of plot

50' x 328'

Site preparation

Plowed to depth of 5" to 8" with disk terracer mounted on Ford-Ferguson tractor, October 8, 1952. Harrowed with spiked-toothed harrow, October 9, 1952. Dragged with railroad irons behind truck, approximately October 20, 1952.

c. 40 BOP, RLH

Planting (species and method)

Species	Symbol	Depth of planting	Number of Replications	Stock planted per spot
Arctostaphylos patula	Apt	0 - 1"	3	2 fruits
Artemisia tridentata	ARt	0 - 3/4"	3	5 fruits (heads)
Atriplex canescens	ATca	0 - 1"	10	5 fruits
Atriplex confertifolia	ATco	0 - 1"	3	5 fruits
Ceanothus cuneatus	Cc	0 - 1"	10	5 seeds
Ceanothus integerrimus	Ci	0 - 1"	3	5 seeds
Cercocarpus betuloides	CEb	0 - 1"	10	5 fruits
Cercocarpus ledifolius	CEl	0 - 1"	10	5 fruits
Chrysothamnus viscidiflorus	CRYv	0 - 3/4"	3	5-8 fruits
Eurotia lanata	EUl	0 - 3/4"	10	5 fruits
Garrya fremontia	GAf	0 - 1"	3	5 fruits
Juniperus occidentalis	Jo	0 - 1"	3	3 fruits
Melilotus alba	MEa	0 - 1"	3	5 seeds
Prunus demissa	PRd	0 - 2"	3	5 fruits
Purshia tridentata	Pt	0 - 2"	10	5 seeds
Sambucus glauca	SBg	0 - 3/4"	3	5 fruits

~~Replications~~
~~Five of each species.~~

Placement and arrangement of planting cans on plot (see diagram)
In rows of 10 cans each; rows spaced 8' apart;
cans spaced 5' apart in the rows. Cans set into soil so
about 2" of top extends aboveground level.
Orientation of cans: planting position number 1 north from center of can.
Cans planted and randomized on plot as shown on the attached list:
Planting Scheme No. 1. (see pages 3, 3a, 3b)

Date of planting
November 10, 1952 (before fall precipitation)

Plot No. 10 (unprotected--not fenced against livestock and deer; see map for location; see plot diagram).

Size of plot

50' x 75'

Site preparation (method and date)
Plowed to depth of 5" to 8" with disk terracer mounted on Ford-Ferguson tractor, October 8, 1952. Harrowed with spiked-toothed harrow, October 9, 1952. Dragged with railroad irons behind truck, approximately October 20, 1952.

PLANTING SCHEME NO. 1

Plot No. 8 (Nursery) Flukey
Spring Experimental Area, 1952

Can No.	Species	
1.	Artemisia tridentata	1/
2	Eurotia lanata	*
3	Atriplex canescens	
4	(Quercus garryana)	*
5	Purshia tridentata	
6	Artemisia tridentata	*
7	Atriplex canescens	
8	Arctostaphyllos patula	*
9	Ceanothus cuneatus	*
10	Chrysothamnus viscidiflorus	
11	Juniperus occidentalis	
12	Purshia tridentata	*
13	Cercocarpus ledifolius	
14	Eurotia lanata	*
15	Ceanothus cuneatus	
16	Ceanothus cuneatus	
17	Atriplex confertifolia	*
18	Atriplex canescens	*
19	Ceanothus integerrimus	
20	Purshia tridentata	*
21	Eurotia lanata	
22	Purshia tridentata	*
23	Ceanothus integerrimus	*
24	Atriplex confertifolia	
25	Garrya fremontia	
26	Cercocarpus ledifolius	*
27	Prunus demissa	
28	Arctostaphyllos patula	
29	Atriplex canescens	*
30	Cercocarpus betuloides	*
31	Ceanothus cuneatus	*
32	Garrya fremontia	*
33	Purshia tridentata	
34	Cercocarpus ledifolius	*
35	Cercocarpus ledifolius	*
36	Sambucus glauca	
37	Cercocarpus betuloides	*
38	(Quercus garryana)	
39	Ceanothus cuneatus	*
40	Purshia tridentata	
41	Eurotia lanata	
42	Cercocarpus ledifolius	*
43	Cercocarpus betuloides	
44	Eurotia lanata	*
45	Cercocarpus betuloides	*
46	Sambucus glauca	*
47	Eurotia lanata	
48	Cercocarpus betuloides	
49	Cercocarpus betuloides	
50	Cercocarpus ledifolius	
51	Ceanothus cuneatus	*
52	Atriplex canescens	
53	Cercocarpus ledifolius	
54	Ceanothus cuneatus	
55	Atriplex canescens	*
56	Juniperus occidentalis	*
57	Cercocarpus ledifolius	
58	Prunus demissa	*
59	Chrysothamnus viscidiflorus	*
60	Ceanothus cuneatus	
61	Eurotia lanata	
62	Arctostaphyllos patula	
63	Purshia tridentata	*
64	Garrya fremontia	*
65	Artemisia tridentata	
66	Cercocarpus ledifolius	
67	Eurotia lanata	*
68	Eurotia lanata	
69	Ceanothus integerrimus	
70	Sambucus glauca	
71	Atriplex confertifolia	*
72	Eurotia lanata	*
73	Cercocarpus ledifolius	*
74	Juniperus occidentalis	
75	Eurotia lanata	*
76	Ceanothus integerrimus	*
77	Ceanothus cuneatus	
78	Cercocarpus betuloides	*
79	Prunus demissa	
80	Purshia tridentata	*

1/ Cans marked with * covered with 1/4" mesh hardware cloth; others not covered.

PLANTING SCHEME NO. 1 (Cont.)

Can No.	Species	
81	Atriplex canescens	
82	Purshia tridentata	
83	Ceanothus cuneatus	
84	Atriplex canescens	*
85	Atriplex canescens	*
86	Cercocarpus ledifolius	
87	Purshia tridentata	
88	(Quercus garryana)	
89	Atriplex canescens	
90	Atriplex confertifolia	
91	Cercocarpus betuloides	*
92	Atriplex canescens	*
93	Ceanothus cuneatus	*
94	Arctostaphyllos patula	*
95	Artemisia tridentata	*
96	(Quercus garryana)	*
97	Cercocarpus betuloides	
98	Ceanothus cuneatus	*
99	Chrysothamnus viscidiflorus	
100	Atriplex canescens	*
101	Garrya fremontia	
102	Prunus demissa	*
103	Atriplex canescens	
104	Juniperus occidentalis	*
105	Chrysothamnus viscidiflorus	*
106	Ceanothus cuneatus	
107	Cercocarpus betuloides	*
108	Cercocarpus betuloides	
109	Cercocarpus ledifolius	*
110	Cercocarpus betuloides	*
111	Eurotia lanata	
112	Purshia tridentata	*
113	Sambucus glauca	*
114	Purshia tridentata	
115	Cercocarpus ledifolius	*
116	Atriplex canescens	
117	Ceanothus cuneatus	*
118	Cercocarpus betuloides	
119	Cercocarpus betuloides	
120	Cercocarpus ledifolius	
121	Atriplex canescens	
122	Cercocarpus betuloides	
123	Atriplex confertifolia	*
124	Cercocarpus ledifolius	*
125	Ceanothus cuneatus	*
126	Sambucus glauca	
127	Artemisia tridentata	*
128	Cercocarpus ledifolius	
129	Garrya fremontia	*
130	(Quercus garryana)	

Can No.	Species	
131	Cercocarpus ledifolius	*
132	Eurotia lanata	
133	Artemisia tridentata	
134	Atriplex canescens	*
135	Cercocarpus betuloides	*
136	Arctostaphyllos patula	
137	Garrya fremontia	
138	Cercocarpus ledifolius	*
139	Prunus demissa	
140	Purshia tridentata	
141	Purshia tridentata	*
142	Chrysothamnus viscidiflorus	
143	Purshia tridentata	*
144	Juniperus occidentalis	
145	Purshia tridentata	
146	Ceanothus cuneatus	
147	Eurotia lanata	
148	Ceanothus integerrimus	
149	Eurotia lanata	*
150	Ceanothus integerrimus	*
151	Purshia tridentata	*
152	Eurotia lanata	*
153	Atriplex canescens	
154	Ceanothus cuneatus	*
155	Cercocarpus betuloides	
156	Purshia tridentata	
157	Atriplex confertifolia	
158	Cercocarpus betuloides	*
159	Cercocarpus betuloides	
160	Sambucus glauca	*
161	Eurotia lanata	*
162	Atriplex canescens	
163	Prunus demissa	*
164	Atriplex canescens	*
165	Eurotia lanata	
166	Atriplex canescens	*
167	Cercocarpus ledifolius	
168	Ceanothus cuneatus	
169	(Quercus garryana)	*
170	Chrysothamnus viscidiflorus	*
171	Ceanothus cuneatus	*
172	Ceanothus cuneatus	
173	Arctostaphyllos patula	*
174	Purshia tridentata	
175	Eurotia lanata	
176	Purshia tridentata	*
177	Cercocarpus betuloides	*
178	Juniperus occidentalis	*
179	Eurotia lanata	*
180	Cercocarpus ledifolius	

PLANTING SCHEME No. 1 (Cont.)

Can No.	Species	
181	Melilotus alba	
182	Melilotus alba	*
183	Melilotus alba	
184	Melilotus alba	*
185	Melilotus alba	
186	Melilotus alba	*

Planting (species and method)

Species	Symbol	Depth of planting	Number of Replications	Stock planted per spot
Artemisia tridentata	ARt	0 - 3/4"	6	5 fruits (heads)
Ceanothus cuneatus	Cc	0 - 1"	10	5 seeds
Cercocarpus ledifolius	CEl	0 - 1"	10	5 fruits
Chrysothamnus viscidiflorus	CRYv	0 - 3/4"	3	5-8 fruits
Garrya fremontia	GAf	0 - 1"	3	5 fruits
Melilotus alba	MEa	0 - 1"	3	5 seeds
Purshia tridentata	Pt	0 - 2"	10	5 seeds

~~Replications~~
~~Five of each species~~

Placement and arrangement of planting cans on plot (see diagram)
In rows of 10 cans each; rows spaced 8' apart; cans spaced 5' apart in the rows. Cans set into soil so about 2" of top extends above ground level.
Orientation of cans: planting position number 1 north from center of can.
Cans planted and randomized on plot as shown on the attached list: Planting Scheme No. 2 (see page 5)

B. Casuse Mt. (cheatgrass type)

Plot No. 1-A (unprotected--not fenced against livestock and deer; see map for location; also M&S No. 1 for design)

Size of plot

30' x 50'

Site preparation (method and date)
Plowed to depth of 8" to 10" with disk terracer mounted on Ford-Ferguson tractor. Harrowed with spiked-toothed harrow. October 10, 1952.

Planting (species and method)

Species	Symbol	Depth of planting	Stock planted per spot
Artemisia tridentata	ARt	0 - 3/4"	5 fruits (heads)
Ceanothus cuneatus	Cc	0 - 1"	5 seeds
Purshia tridentata	Pt	0 - 2"	5 seeds

Replications
~~Five~~ of each species
Ten

PLANTING SCHEME NO. 2

Plot No. 10 (outside) Flukey
Spring Experimental Area, 1952

Can No.	Species	1/
1	Purshia tridentata	*
2	Cercocarpus ledifolius	
3	Cercocarpus ledifolius	*
4	Ceanothus cuneatus	*
5	Ceanothus cuneatus	
6	Artemisia tridentata	*
7	Cercocarpus ledifolius	
8	Artemisia tridentata	
9	Cercocarpus ledifolius	*
10	Artemisia tridentata	*
11	Chrysothamnus viscidiflorus	*
12	Purshia tridentata	*
13	Ceanothus cuneatus	*
14	Melilotus alba	
15	Ceanothus cuneatus	*
16	Garrya fremontia	
17	Cercocarpus ledifolius	*
18	Cercocarpus ledifolius	*
19	Artemisia tridentata	*
20	Cercocarpus ledifolius	*
21	Ceanothus cuneatus	*
22	Purshia tridentata	*
23	Purshia tridentata	
24	Chrysothamnus viscidiflorus	
25	Artemisia tridentata	
26	Ceanothus cuneatus	
27	Ceanothus cuneatus	*
28	Purshia tridentata	*
29	Purshia tridentata	*
30	Ceanothus cuneatus	
31	Ceanothus cuneatus	
32	Garrya fremontia	*
33	Cercocarpus ledifolius	
34	Purshia tridentata	
35	Purshia tridentata	*
36	Cercocarpus ledifolius	*
37	Cercocarpus ledifolius	*
38	Ceanothus cuneatus	*
39	Chrysothamnus viscidiflorus	*
40	Garrya fremontia	
41	Ceanothus cuneatus	*
42	Artemisia tridentata	*
43	Ceanothus cuneatus	*
44	Melilotus alba	*
45	Chrysothamnus viscidiflorus	
46	Ceanothus cuneatus	
47	Purshia tridentata	
48	Chrysothamnus viscidiflorus	
49	Purshia tridentata	*
50	Cercocarpus ledifolius	*
51	Ceanothus cuneatus	
52	Purshia tridentata	*
53	Cercocarpus ledifolius	
54	Melilotus alba	*
55	Ceanothus cuneatus	
56	Artemisia tridentata	*
57	Melilotus alba	
58	Cercocarpus ledifolius	
59	Garrya fremontia	*
60	Purshia tridentata	
61	Artemisia tridentata	
62	Purshia tridentata	*
63	Purshia tridentata	*
64	Garrya fremontia	*
65	Cercocarpus ledifolius	
66	Cercocarpus ledifolius	
67	Cercocarpus ledifolius	
68	Artemisia tridentata	
69	Melilotus alba	
70	Purshia tridentata	
71	Purshia tridentata	
72	Purshia tridentata	
73	Ceanothus cuneatus	
74	Artemisia tridentata	
75	Purshia tridentata	
76	Purshia tridentata	*
77	Artemisia tridentata	
78	Ceanothus cuneatus	
79	Garrya fremontia	
80	Cercocarpus ledifolius	*
81	Melilotus alba	*
82	Ceanothus cuneatus	*
83	Cercocarpus ledifolius	*
84	Artemisia tridentata	*
85	Purshia tridentata	
86	Ceanothus cuneatus	*
87	Cercocarpus ledifolius	
88	Ceanothus cuneatus	
89	Cercocarpus ledifolius	
90	Chrysothamnus viscidiflorus	*

1/ Cans marked with * covered with 1/4" mesh hardware cloth; others not covered.

Placement and arrangement of planting cans on plot (see diagram)
In rows of 10 cans each; 6 rows spaced 8' apart; cans spaced 5' apart in the rows. Cans set into soil so about 2" of top extends above ground level.
Orientation of cans: planting position number 1 east from center of can.
Cans planted and randomized on plot as shown on the attached list: Planting Scheme No. 3. ~~Cans numbered 1 to 30 listed on planting scheme located on this plot.~~
(see page 7)

Plot No. 2-A (unprotected--not fenced against livestock and deer; see map for location; also M&S No. 1 for design)

Size of plot

30' x 50'

Site preparation (method and date)
Plowed to depth of 8" to 10" with disk terracer mounted on Ford-Ferguson tractor. Harrowed with spiked-toothed harrow. October 10, 1952.

Planting (species and method)

Species	Symbol	Depth of planting	Stock planted per spot
Artemisia tridentata	ARt	0 - 3/4"	5 fruits (heads)
Ceanothus cuneatus	Cc	0 - 1"	5 seeds
Purshia tridentata	Pt	0 - 2"	5 seeds

Replications
~~Five~~ Ten of each species

Placement and arrangement of planting cans on plot (see diagram)
In rows of 10 cans each; rows spaced 8' apart; cans spaced 5' apart in the rows. Cans set into soil so about 2" of top extends above ground level.
Orientation of cans: planting position number 1 east from center of can.
Cans planted and randomized on plot as shown on the attached list: Planting Scheme No. 3. (~~Cans numbered 31 to 60 listed on planting scheme located on this plot.~~
(see page 7) (Same as Plot No. 1-A)

PLANTING SCHEME NO. 3

Plots No. 1-A and 2-A Casuse Mt. and Plots 1-A and 2-A Doyle Area (inside cultivated area and out)

Can No.	Species	
1	Artemisia tridentata	*[1]
2	Ceanothus cuneatus	*
3	Artemisia tridentata	
4	Purshia tridentata	*
5	Artemisia tridentata	*
6	Purshia tridentata	
7	Purshia tridentata	*
8	Purshia tridentata	
9	Purshia tridentata	
10	Purshia tridentata	
11	Ceanothus cuneatus	
12	Artemisia tridentata	
13	Ceanothus cuneatus	
14	Artemisia tridentata	
15	Artemisia tridentata	*
16	Purshia tridentata	
17	Ceanothus cuneatus	
18	Ceanothus cuneatus	*
19	Artemisia tridentata	
20	Ceanothus cuneatus	
21	Purshia tridentata	
22	Artemisia tridentata	*
23	Artemisia tridentata	
24	Purshia tridentata	
25	Purshia tridentata	*
26	Artemisia tridentata	*
27	Purshia tridentata	*
28	Purshia tridentata	
29	Artemisia tridentata	*
30	Ceanothus cuneatus	*
31	Artemisia tridentata	
32	Ceanothus cuneatus	*
33	Artemisia tridentata	*
34	Ceanothus cuneatus	*
35	Ceanothus cuneatus	
36	Purshia tridentata	*
37	Ceanothus cuneatus	*
38	Artemisia tridentata	*
39	Ceanothus cuneatus	
40	Artemisia tridentata	
41	Purshia tridentata	*
42	Ceanothus cuneatus	*
43	Ceanothus cuneatus	*
44	Ceanothus cuneatus	
45	Ceanothus cuneatus	
46	Artemisia tridentata	
47	Ceanothus cuneatus	
48	Artemisia tridentata	*
49	Ceanothus cuneatus	
50	Purshia tridentata	*
51	Ceanothus cuneatus	*
52	Ceanothus cuneatus	*
53	Purshia tridentata	
54	Artemisia tridentata	
55	Purshia tridentata	
56	Artemisia tridentata	*
57	Purshia tridentata	*
58	Purshia tridentata	*
59	Purshia tridentata	*
60	Artemisia tridentata	

[1] Cans marked with * covered with 1/4" mesh hardware cloth; others not covered.

C. Doyle (sagebrush-cheatgrass type)

Plot No. 1-A (protected--fenced against livestock and deer; see map for location)

Size of plot

30' x 50'

Site preparation (method and date)
Plowed to depth of 8" to 10" with disk terracer mounted on Ford-Ferguson tractor. Harrowed with spiked-toothed harrow. December 1952.

Planting (species and method)

Species	Symbol	Depth of planting	Stock planted per spot
Artemisia tridentata	ARt	0 - 3/4"	5 fruits (heads)
Ceanothus cuneatus	Cc	0 - 1"	5 seeds
Purshia tridentata	Pt	0 - 2"	5 seeds

Replications
~~Five~~ Ten of each species

Placement and arrangement of planting cans on plot
In rows of 10 cans each; rows spaced 8' apart; cans spaced 5' apart in the rows. Cans set into soil so about 2" of top extends above ground level.
Orientation of cans: planting position number 1 north from center of can.
Cans planted and randomized on plot as shown on the attached list: Planting Scheme No. 3 (see page 7). All 60 cans planted in this plot.

Planting date
~~December~~ November 19, 1952.

Plot No. 2-A (protected--fenced against livestock and deer; see map for location)

Size of plot

30' x 50'

Site preparation (method and date)
Not plowed.

Planting (species and method)

Species	Symbol	Depth of planting	Stock planted per spot
Artemisia tridentata	ARt	0 - 3/4"	5 fruits (heads)
Ceanothus cuneatus	Cc	0 - 1"	5 seeds
Purshia tridentata	Pt	0 - 2"	5 seeds

Replications
~~Five~~ Ten of each species

Placement and arrangement of planting cans on plot
Cans set in an undistributed plant cover except that brought about by the setting and planting of the cans.
Planting Scheme No. 3 (see page 7). All 60 cans planted in this plot.

D. Wells Meadow (sagebrush-Mormon tea)

Plots 1, 1-A, 2 and 2-A (protected--fenced against livestock and deer; see map for location; see plot diagram)

This installation is basically the same as the one at Doyle except for the following:

Planting (species and method)

Species	Symbol
Artemisia tridentata	ARt
Atriplex canescens	ATca
Atriplex confertifolia	ATco
Ceanothus cuneatus	Cc
Purshia tridentata	Pt

Replications
Ten of each species

Placement and arrangement of planting cans on plot
Cans planted and randomized on plot as shown on the attached list:
Planting Scheme No. 4 (see page 10), used on plots 1-A and 2-A. and 10a

Planting date
December 12, 1952

PLANTING SCHEME NO. 4

Plots 1-A and 2-A, Wells Meadow

Can No.	Species	
1	Atriplex confertifolia	
2	Ceanothus cuneatus	
3	Atriplex canescens	
4	Ceanothus cuneatus	
5	Atriplex canescens	1/
6	Ceanothus cuneatus	*
7	Artemisia tridentata	
8	Atriplex confertifolia	
9	Atriplex canescens	
10	Atriplex confertifolia	
11	Artemisia tridentata	
12	Artemisia tridentata	*
13	Atriplex confertifolia	
14	Artemisia tridentata	*
15	Purshia tridentata	
16	Purshia tridentata	*
17	Ceanothus cuneatus	*
18	Purshia tridentata	
19	Artemisia tridentata	*
20	Purshia tridentata	
21	Artemisia tridentata	
22	Artemisia tridentata	
23	Purshia tridentata	
24	Ceanothus cuneatus	*
25	Artemisia tridentata	*
26	Atriplex confertifolia	*
27	Atriplex confertifolia	
28	Artemisia tridentata	*
29	Atriplex canescens	
30	Purshia tridentata	*
31	Ceanothus cuneatus	
32	Purshia tridentata	*
33	Ceanothus cuneatus	
34	Atriplex confertifolia	*
35	Atriplex canescens	
36	Atriplex canescens	*
37	Atriplex canescens	*
38	Ceanothus cuneatus	*
39	Ceanothus cuneatus	
40	Purshia tridentata	*
41	Ceanothus cuneatus	
42	Ceanothus cuneatus	*
43	Atriplex canescens	*
44	Atriplex confertifolia	
45	Purshia tridentata	*
46	Atriplex confertifolia	*
47	Ceanothus cuneatus	*
48	Ceanothus cuneatus	
49	Atriplex canescens	
50	Artemisia tridentata	
51	Ceanothus cuneatus	*
52	Ceanothus cuneatus	
53	Ceanothus cuneatus	*
54	Purshia tridentata	
55	Atriplex confertifolia	
56	Atriplex confertifolia	*
57	Artemisia tridentata	*
58	Purshia tridentata	*
59	Atriplex canescens	
60	Atriplex canescens	*
61	Artemisia tridentata	
62	Artemisia tridentata	*
63	Atriplex confertifolia	*
64	Atriplex canescens	*
65	Purshia tridentata	*
66	Atriplex confertifolia	*
67	Ceanothus cuneatus	*
68	Atriplex confertifolia	*
69	Purshia tridentata	
70	Atriplex confertifolia	
71	Atriplex canescens	
72	Atriplex canescens	*
73	Atriplex confertifolia	*
74	Atriplex canescens	*
75	Purshia tridentata	
76	Atriplex confertifolia	
77	Atriplex confertifolia	*
78	Ceanothus cuneatus	
79	Purshia tridentata	*
80	Purshia tridentata	
81	Purshia tridentata	
82	Ceanothus cuneatus	*
83	Atriplex confertifolia	
84	Atriplex canescens	
85	Atriplex confertifolia	*
86	Purshia tridentata	*
87	Artemisia tridentata	*
88	Atriplex canescens	*
89	Artemisia tridentata	*
90	Artemisia tridentata	

1/ Cans marked with * covered with 1/4" mesh hardware cloth; others not covered.

PLANTING SCHEME NO. 4 (Cont.)

Can No.	Species	
91	Atriplex canescens	
92	Artemisia tridentata	
93	Purshia tridentata	*
94	Atriplex canescens	*
95	Ceanothus cuneatus	
96	Atriplex canescens	*
97	Artemisia tridentata	
98	Artemisia tridentata	*
99	Purshia tridentata	
100	Artemisia tridentata	

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W-6R-1
Game Range Restoration

CF&RES
B. O. Pearson
March 21, 1953

STUDY PROGRESS REPORT

Subject: Studies - Germination

1. Background

Germination in cans planted December 1952 with Atriplex canescens, Atriplex confertifolia, Ceanothus cuneatus, Artemisia tridentata and Purshia tridentata, as observed March 17, 1953 by Hubbard and Pearson at Wells Meadow, Inyo County, California.

2. Results

(a) The soil in the open cans had drifted from the No. 2 position (east side) to the No. 4 position (west side) in the clean cultivated site. Movement in some cans was as much as 3/4" deposit on No. 4 location.

(b) Soil was dry to the 2 - 2½" level.

(c) Negative report on germination of:

Artemisia tridentata
Ceanothus cuneatus
Atriplex canescens
Atriplex confertifolia

(d) Total Purshia tridentata germinating in all cans was as follows:

Depth class:	Clean cultivated site : Open	: Rodent proof	Undisturbed site : Open	: Rodent proof	: Total
1					
2					
3		1			1
4		1		6	7
5	3	7	4	7	21
Total	3	9	4	13	29

c. to AHH, BOP, RLH, file

STATE California

PROJECT NO. W46R-1

DATE April 1, 1953

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
3. Leaders: M. W. Talbot and A. L. Hormay, assisted by Richard L. Hubbard and Bennett O. Pearson
4. Cooperating Agency: California Forest and Range Experiment Station
5. Summary report of progress during the third quarter, January 1 to March 31, 1953. (This report is not for publication.)

Purpose

The primary objective of this project is to develop cultural methods of re-establishing and extending browse species suitable for food or cover on deteriorated game ranges in California. Both native and introduced species are being considered in these studies. The work is being started in the East-side Region of the State on deer winter ranges which cover a distance of about 500 miles from Oregon to the southern end of the Sierra Nevada mountains. These ranges are heavily deteriorated. They lie in a comparatively light snow belt, but in heavy precipitation years the snow pack covers up low growing forage and hinders the movement of the deer. Under these conditions shrubs are premium forage plants because of their upstanding growth habit. Bitter-brush (Purshia tridentata) is the most important game browse in the region and is being given special attention in the present studies.

General Accomplishments

(a) Most of the past quarter was devoted to more complete organizing of the project, planning experiments and getting ready with facilities, equip-ment and materials for a heavy spring field-work period; (b) a limited seed germination study was started in the laboratory.

Details of Accomplishments

Organization

Considerable time was spent in developing time-saving elements of work plans, particularly in standardizing the form of plans, recording sheets, reports and correspondence. The subject list on pages 2 and 3 of the Fiscal Year 1953 study plan which covers the general field of study of the project was revised and expanded to read as follows:

A. Species

- Stock
- Germination
- Establishment
- Growth and reproduction
- Site adaptability
- Pests and diseases
- Forage yield
- Range value

B. Site factors

- Weather
- Soil (type)
- Soil fertility
- Soil moisture
- Grazing
- Fire

C. Site preparation and maintenance

- Mechanical
- Chemical
- Fire
- Grazing
- Biological

D. Planting methods

- Time
- Depth
- Rate
- Species composition
- Equipment

E. General

Additional headings will be added under A, B, C and D as needed. These headings together with the following more general ones -- Organization, Surveys, Experimental Areas and Plots, Plans, Methods and Specifications, Reports, Publications, Meetings and Extension, Cooperation -- will be used as needed in plans, reports and correspondence starting with the present quarterly report.

Methods and Specifications

Deer-livestock exclosures

Plots from which deer and livestock are excluded are essential in the present studies to protect experimental seedlings needed in interpreting the effectiveness of various plot treatments and planting methods. Such exclosures have been planned for three experimental areas -- Flukey Spring, Doyle, and Wells Meadow. Construction was started during the quarter and the stage of completion of each exclosure is shown in Table 1.

Table 1.--Location and construction-status of deer-livestock exclosures

No. of exclosures	Location		Size		Construction status
	Experimental area	County	Dimensions (feet)	Area (acres)	
1	Flukey Spring	Modoc	367 x 520	4.38	Not started
1	Doyle	Lassen	132 x 264	0.80	Completed
1	Wells Meadow	Inyo	132 x 264	0.80	Half completed

An outrigger type fence is used in these installations. The vertical section is 4.5 feet high. It is faced with 11-gage 2- x 4-inch wire mesh from the top of the fence down to a depth of 18 inches below the ground level. The outrigger extends from the top of the fence outward and downward to a point 8 feet out from the base of the fence. It is supported by metal posts tied to each line post on the upright fence and is faced with 10 strands of 12½-inch gage smooth twisted wire which run lengthwise of the fence. Four strands, spaced 6 inches apart, cover the upper portion of the incline and 6 strands spaced 12 inches apart cover the lower portion. The fence is all-metal to resist fire. It was designed for light snowfall or rainfall areas.

Soil moisture measurement installations

Soil moisture measurement stations were planned for three experimental areas -- Flukey Spring, Doyle, and Wells Meadow. Those at Flukey Spring and Wells Meadow were installed. The one at the Doyle area will be set up within the month.

At these stations electrical soil moisture elements 1/ are being placed at 1.5, 4.5, 9, 15, 21, 30, 42 and 54 inches below the soil surface in a column to get a picture of the seasonal variation in moisture in this zone. The amount of moisture in this section of the soil has a strong bearing on seed germination and seedling establishment and such practical reseeding measures as site preparation, time and depth of planting, and others.

1/ Manual of instructions for use of the fiberglas soil-moisture instrument, by E. A. Colman. October 1947; revised June 1952. 20 pp.

The stations are located inside the deer-livestock exclosures on the three experimental areas. Plans call for setting out one stack of elements on an area cleared of vegetation in each exclosure. At Flukey Spring a second stack was located on an uncleared area comparable in site to the cleared.

Site Preparation and Maintenance

Chemical

Information was obtained from various sources on chemicals that could be used to eliminate or control the existing vegetation on the experimental planting sites. This cover consists of shrubs (sprouting and non-sprouting) and annual and perennial grasses and forbs. The chemicals chosen for testing this spring are:

1. 2,4-D — 2:4-dichlorophenoxyacetic acid:butyl ester
2. 2,4,5-T — 2:4:5-trichlorophenoxyacetic acid
3. MH — maleic hydrazide 1:2-dihydropyridazine-3:6-diene
4. IPC — N-phenyl isopropyl carbamate
5. TCA — trichloracetic acid
6. CMU — 3-(p-chlorophenyl)-1:1-dimethyl urea (DuPont Weed Killer)
7. PCP — pentachlorophenol

All of these, with the possible exception of PCP, are selective in some degree in their action on the various plant species. The classes of vegetation that these chemicals are directed toward are shown in Table 2.

Table 2.--Chemicals and classes of vegetation to be treated

Classes of vegetation	Chemicals						
	2,4-D	2,4,5-T	MH	IPC	TCA	CMU	PCP
Shrubs and trees							X
Sprouting		X					
Non-sprouting	X						
Grasses							X
Perennial bunchgrasses			X	X	X	X	
Annuals			X	X	X	X	
Forbs							X
Perennials	X	X					
Annuals	X						

Plots will be treated at different plant growth stages with various concentrations and formulations of these chemicals.

Mechanical and fire

A few plots will be cleared by plowing or discing and others by burning. An attempt will be made to time these treatments so as to minimize or prevent natural reseeding and regrowth of the species being cleared from the site.

Species

Germination

Laboratory.--The time available for seed germination studies in the laboratory was very limited. A preliminary screening test was made with 13 plant species. Seeds or fruits of these species were kept on moist filter paper in Petri dishes at 76° F. + 2° F. These conditions are normally favorable for germination and growth. The germination obtained is shown in Table 3. Bitterbrush was not included in these tests because the germination behavior of both the seed and fruit of this species was worked out in considerable detail in earlier work at this Station.

Fruits of silver sagebrush, big sagebrush, and rabbitbrush and seeds of four-wing saltbush and shad-scale germinated readily in appreciable numbers. The other species showed little or no signs of activity, indicating dormancy or non-viability. Further testing is designed to determine the cause of dormancy where it exists and to work out methods of overcoming it. The failure of the seed to germinate under what appears to be favorable conditions for growth stems from many causes and varies by species. In four-wing saltbush and shad-scale, for example, removal of the appressed, thickened, winged foliaceous bracts from around the seed permits the seed to germinate. Seed handling, cleaning and storage will also receive systematic attention.

In these germination studies consideration will be given to most of the important species growing on the planting sites -- the forbs and grasses as well as shrubs, and undesirable as well as desirable species. This information is needed in solving many site preparation and cover improvement problems. A knowledge of the viability, longevity in the soil, and germination behavior of such relatively undesirable species as big sagebrush, rabbitbrush and cheatgrass, for example, is important in establishing and maintaining desirable browse stands in the Eastside Region.

Field.--The first seedlings from last fall's plantings (see January Quarterly Progress Report) started to emerge about the middle of March. Early results will be outlined in the next quarterly progress report.

Cooperation

This project will benefit greatly from the experience and information available at the Western Forest and Range Experiment Stations and administrative units of the Forest Service, and from the helpful cooperation extended by State Fish and Game Departments, the Bureau of Land Management, the University of California, and other agencies.

SUBMITTED BY

M. M. Talbot
Project Leader

APPROVED BY:
CALIFORNIA DEPARTMENT OF FISH AND GAME

By _____
Chief, Bureau of Game Conservation

DATE _____

Table 3.--Germination of shrub species (in Petri dishes at 76°F.)

Species		Material used	Number tested	Germination		Period of test (days)
Common name	Scientific name			Number	Percent	
Greenleaf manzanita	Arctostaphylos patula	Seeds	25	0	0	32
Silver sagebrush	Artemisia cana	Fruits	50	50	100	8
Big sagebrush	Artemisia tridentata	Fruits	50	35	70	32
Four-wing saltbush	Atriplex canescens	Fruits	50	0	0	32
do	do	Seeds	10	9	90	26
Shadscale	Atriplex confertifolia	Fruits	50	0	0	32
do	do	Seeds	10	5	50	26
Wedgeleaf ceanothus	Ceanothus cuneatus	Seeds	100	0	0	32
Deerbrush	Ceanothus integerrimus	Seeds	100	0	0	32
Birchleaf mahogany	Cercocarpus betuloides	Fruits	50	1	2	32
do	do	Seeds	25	0	0	7
Curl-leaf mahogany	Cercocarpus ledifolius	Fruit	50	1	2	32
Rubber rabbitbrush	Chrysothamnus nauseosus	Fruit	50	32	64	32
Fremont silk tassel	Garrya fremontia	Seeds	25	0	0	32
Western chokecherry	Prunus demissa	Fruit	25	0	0	32
Horsebrush	Tetradymia canescens	Fruit	25	0	0	32

STATE California

PROJECT NO. W-6-R-1

DATE January 5, 1953

QUARTERLY PROGRESS REPORT

SURVEYS AND INVESTIGATIONS

as required by

FEDERAL AID IN WILDLIFE RESTORATION ACT

1. Title of Project: Game Browse Restoration

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

3. Leaders: M. W. Talbot and A. L. Hormay, assisted by Richard L. Hubbard and Bennett O. Pearson

4. Cooperating Agency: California Forest and Range Experiment Station

5. Summary report of progress during the second quarter, October 1 to December 31, 1952. (This report is not for publication.)

Purpose

The main purpose of this project is to develop ways of restoring browse on deteriorated big game ranges by cultural methods like artificial reseeding. The project was set up on a State-wide basis. However, the initial research is being directed to deer winter range problems in the Eastside region of the State -- the easterly slopes of the Sierra Nevada-Cascade mountains -- with special emphasis on the re-establishment of bitterbrush.

General Accomplishments

(1) An inspection was made of browse conditions on deer winter ranges in the Eastside region. (2) Three experimental areas in addition to the Flukey Spring area were located and established in the Eastside region. (3) On all four experimental areas plots were planted with some species important on game ranges.

Details of Accomplishments

Personnel

Bennett O. Pearson was transferred from the Inyo National Forest to the Experiment Station and reported to work on the browse project on October 13.

Deer Winter Range Inspection and Establishment of New Experimental Area

M. W. Talbot, A. L. Hormay, and R. L. Hubbard, under the guidance of William P. Dasmann of the California Department of Fish and Game, took a fresh look at the browse restoration problems in the Eastside region from Doyle to Bishop -- a stretch of about 250 miles.

Some of the personnel contacted enroute included:

California Department of Fish and Game
James Blaisdell
Homer Bryan
Arthur Hensley

Nevada Department of Fish and Game
Joseph Greenley

U. S. Forest Service
Region 4
Elmer Boyle
Gilbert B. Doll
Norman Hack
Region 5
Eldon E. Ball
Adelbert Fausett

These men showed keen interest in the project and offered help and cooperation within their means. These contacts paved the way for establishing two new experimental areas in the deer winter range belt, one near Doyle and the other near Bishop. Another such area was set up earlier in the month near Casuse Mt. about 10 miles north of the Flukey Spring area in Modoc County. The four experimental areas now established are representative of some of the more important problems and conditions found on the deer winter ranges. A general description of these experimental areas is given in Table 1.

The trip brought out three other rather significant points:

1. The importance of bitterbrush was re-emphasized. The men in the field considered bitterbrush by far the most valuable and most desired deer browse growing on Eastside ranges at the present time.

In many locations this species has been heavily damaged or killed out. Generally speaking big sagebrush and cheatgrass are now dominant on these areas. The development of practical techniques for reducing or eliminating these and other competing plants from these sites presents a major research problem in the restoration of bitterbrush and other browse.

2. Eastside deer winter range is highly diverse and site conditions vary from one section of the range to the next. It is apparent that no one general planting formula will satisfy all conditions. Different formulas will have to be prepared for the major sites. Fall planting is indicated for the wetter sites and spring planting for the drier. Conditions favoring the

Table 1.--General description of principal experimental areas

Name of area	Location	Ownership or jurisdiction	Altitude (approx.)	Seasonal precipitation (approx.)		Soil	Cover type
				Aver. inches	Range inches		
1. Flukey Spring	Modoc County, near Perez	U. S. Forest Service	4,300 ft.	12	8 - 22	Fine sandy loam from lava	Sagebrush, juniper, cheatgrass
2. Casuse Mt.	Modoc County, near Perez	U. S. Forest Service	4,300 ft.	10	8 - 15	Fine sandy loam from lava	Cheatgrass, mustard
3. Doyle	Lassen County, near Doyle	State of California	4,300 ft.	10	7 - 12	Coarse sandy loam from granite	Sagebrush, cheatgrass
4. Wells Meadow	Inyo County, near Bishop	Bureau of Land Management	4,450 ft.	6	1 - 15	Coarse sandy loam from granite	Sagebrush, Mormon tea

germination and establishment of seedlings will no doubt occur infrequently in the drier areas. Here time of planting is very important. Consistent planting success probably will rest on planting after soil moisture, sufficient to insure germination and establishment, is assured. Under these conditions pretreated seeds will have to be used to obtain rapid germination.

3. Sprouting of bitterbrush following burning is rare in California. One of these cases was observed near Bishop during the inspection trip. Here vigorous sprouting occurred in a stand swept by an early spring fire. Some of the sprouts originated from buds located as much as 8 inches below the soil surface. It could not be determined whether sprouting was due to the genetic makeup of the plant, the site, the time of burning, or some other factor.

For the purposes of this project it is hoped that sprouting is an inherited genetic quality in some strains of bitterbrush. Establishment of sprouting forms of bitterbrush in California would greatly reduce the damaging effect of fire and grazing on the stands.

Bitterbrush resprouts commonly following burning in certain sections of the Great Basin region -- for example on the Snake River plains in Idaho. Experimental materials will be obtained from these and local sources in the search for sprouting forms suited to California conditions.

Experimental Plantings

Plots on the four experimental sites were planted with seeds of several browse species. The main purpose of these trials is to get leads on the important factors controlling browse restoration in the study region. The plantings were designed to provide information on seed germination, time and depth of planting, the effect of plant competition on seed germination and seedling establishment, the effect of rodents, birds and insects on seeds and seedlings, and to a limited extent the effect of deer and livestock grazing on seedling establishment.

Some of the plantings were made in approximately gallon size cans in which the tops and bottoms were cut out and the side perforated to permit free movement of moisture. Three to ten cans were planted per species-treatment. Seeds were planted at five different depths in each can. Half the cans were screened against rodents and birds with 1/4-inch hardware cloth. Some of the cans will lie inside deer-livestock exclosures and others outside. The necessary fences will be constructed by the time the seedlings germinate in the spring. The species planted and the conditions of planting in these can installations on the four planting areas are brought out in Table 2.

In addition to these can setups, a few drill and broadcast plots were established at Flukey Spring and Casuse Mt., using bitterbrush and crested wheatgrass (Table 3). The main purpose of these plantings is to throw light on the effect of plant competition on the germination and survival of the species planted -- principally bitterbrush.

Table 2.—Plantings in "can setups" on four experimental areas[1/]
1952

Experimental area and species planted	Range of planting depth	Conditions of planting					
		Inside deer-livestock exclosure				Outside deer livestock exclosure	
		Cultivated seedbed		Untreated seedbed[2/]		Cultivated seedbed	
		Open top cans	Screened top cans	Open top cans	Screened top cans	Open top cans	Screened top cans
	In.	Number of cans					
FLUKEY SPRING							
Artemisia tridentata (big sagebrush)	0 - 3/4	3	3	-	-	6	6
Ceanothus cuneatus (buck-brush)	0 - 1	10	10	-	-	10	10
Purshia tridentata (bitterbrush)	0 - 2	10	10	-	-	10	10
Others:							
Arctostaphylos patula (greenleaf manzanita)	0 - 1	3	3	-	-	-	-
Ceanothus integerrimus (deerbrush)	0 - 1	3	3	-	-	-	-
Cercocarpus betuloides (birchleaf mahogany)	0 - 1	10	10	-	-	-	-
Cercocarpus ledifolius (mountain mahogany)	0 - 1	10	10	-	-	10	10
Garrya fremontii (bear brush)	0 - 1	3	3	-	-	3	3
Juniperus occidentalis (Sierra juniper)	0 - 1	3	3	-	-	-	-
Melilotus alba (white sweetclover - herb)	0 - 1	3	3	-	-	3	3
Prunus demissa (western chokeberry)	0 - 2	3	3	-	-	-	-
Sambucus glauca (elderberry)	0 - 3/4	3	3	-	-	-	-
CASUSE MT.							
Artemisia tridentata (big sagebrush)	0 - 3/4	-	-	-	-	10	10

(Cont. on next page)

Table 2.--Plantings in "can setups" on four experimental areas[1/]
1952 (Cont.)

Experimental area and species planted	Range of planting depth	Conditions of planting					
		Inside deer-livestock exclosure				Outside deer livestock exclosure	
		Cultivated seedbed		Untreated seedbed[2/]		Cultivated seedbed	
		Open top cans	Screened top cans	Open top cans	Screened top cans	Open top cans	Screened top cans
	In.	Number of cans					
Ceanothus cuneatus (buck-brush)	0 - 1	-	-	-	-	10	10
Purshia tridentata (bitterbrush)	0 - 2	-	-	-	-	10	10
DOYLE							
Artemisia tridentata (big sagebrush)	0 - 3/4	10	10	10	10	-	-
Ceanothus cuneatus (buck-brush)	0 - 1	10	10	10	10	-	-
Purshia tridentata (bitterbrush)	0 - 2	10	10	10	10	-	-
WELLS MEADOW							
Artemisia tridentata (big sagebrush)	0 - 3/4	10	10	10	10	-	-
Ceanothus cuneatus (buck-brush)	0 - 1	10	10	10	10	-	-
Purshia tridentata (bitterbrush)	0 - 2	10	10	10	10	-	-
Others:							
Atriplex canescens (four-wing saltbush)	0 - 1	10	10	10	10	-	-
Atriplex confertifolia (spiny saltbush)	0 - 1	10	10	10	10	-	-

1/ In each can seeds were planted at five different depths, from 0 inches to a depth that was estimated to prevent emergence.

2/ See Table 1 for general description of plant cover.

Table 3.--Drill and broadcast plantings on the Flukey Spring and Casuse Mt. areas. 1952.

Experimental area and plot No.	Method of sowing	Type of seedbed	Species planted	Approx. rate of seeding per acre	Plot size	Fence protection
FLUKEY SPRING				Lbs.		
1	Drill	Plowed - smoothed	Bitterbrush	4	20' x 300'	Deer - livestock
2	Drill	Plowed - smoothed	Bitterbrush - crested wheat mixture	4 - 8	20' x 300'	Deer - livestock
7	Drill	Plowed - smoothed	Bitterbrush - crested wheat mixture	4 - 8	20' x 100'	None
5	Drill	Plowed - smoothed	Bitterbrush - crested wheat white sweet clover (each species sown from different drill spouts)	4 8 4	20' x 300'	Deer - livestock
6	Drill	Untreated	Bitterbrush - crested wheat mixture	4 - 8	20' x 300'	Deer - livestock
4	Broadcast	Plowed - disked rough	Bitterbrush - crested wheat mixture	4 - 8	40' x 150'	Deer - livestock
3	Broadcast and disked in	Plowed - smoothed	Bitterbrush - crested wheat mixture	4 - 8	40' x 150'	Deer - livestock
CASUSE MT.						
1	Drill	Plowed - smoothed	Bitterbrush	4	20' x 100'	None
2	Drill	Plowed - smoothed	Bitterbrush - crested wheat mixture	4 - 8	20' x 100'	None

Cooperation

Various agencies have cooperated in material ways to get this project started and keep it rolling. It would not have been possible to set up the plots that are now installed in the short time that was available were it not for the prompt generous help given by these agencies.

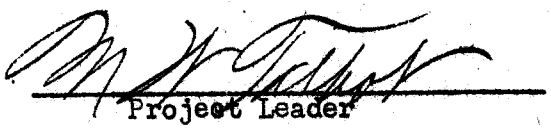
The Modoc National Forest undertook the heavy job of clearing a portion of the Flukey Spring area of juniper, down logs, and sagebrush cover and clearing firebreaks around various plots.

Department of Fish and Game personnel under the supervision of Jim Blaisdell cleared and prepared the Doyle plot for planting, furnishing both equipment and manpower.

The Bureau of Land Management provided the land for the Wells Meadow plot through arrangements made by the Inyo National Forest which located and prepared the plot for planting.

These agencies will construct the fences around the plots and will help in many ways as the research program unfolds.

SUBMITTED BY



Project Leader

APPROVED BY:
CALIFORNIA DEPARTMENT OF FISH AND GAME

By _____
Chief, Bureau of Game Conservation

DATE _____

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W-6R-1

CF&RES
April 3, 1953

JOB PLAN

April 1 to 30, 1953

Objectives:

1. Install soil moisture station on the Doyle experimental area.

2. Start systematic plant growth and development measurements on experimental areas.

3. Start systematic soil moisture measurements on experimental areas.

4. Examine all plots planted last fall and this spring for seedling emergence.

5. Locate and lay out experimental plots to be sprayed with chemicals for testing site preparation methods.

6. Lay out quadrats and transects and measure vegetation on spray plots prior to spraying.

7. Start chemical spraying.

8. Plant bitterbrush seed in can setups on the Flukey Spring and Casuse Mt. areas (hand plantings).

RR
COOPERATION
State of California
Department of Fish and Game
Project W46R-1
Game Range Restoration

CF&RES
B. O. Pearson
April 15, 1953

STUDY PROGRESS REPORT

Subject: Site preparation and maintenance - chemical sprays

1. Background

See Annual Work Plan 1952; also General Plan of January 15, 1953 and Line of Work Study Plan of November 24, 1952 by A. L. Hormay.

Reduction of the existing plant cover on planting sites is essential for the establishment and proper growth of artificially reseeded browse and other species on game ranges in the Eastside Region of California. Plans are formulated to test the effectiveness of various chemicals in reducing or controlling the existing plant cover.

Some of the more abundant plant species that will probably have to be controlled on deer winter ranges in the Eastside Region of California are as follows:

Trees	Shrubs	Forbs	Grasses
Juniper	Big sagebrush	Mustard	Cheatgrass
Pinyon pine	Black sagebrush	Asters	Annual bluegrass
	Rabbitbrush	Phacelias	Squirreltail
	Bitterbrush	Filaree	Little bluegrass
	Mormon tea	Turpentine weed	Needlegrass
	Blackbrush		Idaho fescue

2. Purpose

To line up and briefly describe chemicals and spray formulations that show promise of being useful in the present study.

3. General Information

A. Number of herbicides available

Approximately 10,000 economic poisons are presently registered as herbicides.

The total possible number of manufactured products for a particular type of herbicide (2,4-D, for example) is limited only to the demand for the product and the ingenuity of the manufacturer to add to the parent acid with ester, amine salts, and surface active agents. The change in the formulation of the herbicide sometimes gives a much greater success in treatment of a given species.

c. to BOP
RLH

B. Formulation of selected herbicides

The use of chemical herbicides in this project is not to test the various formulations of each chemical, but to use a successful formulation of the apparently usable chemicals for pilot trials.

To obtain this information, references were checked at the University of California Library, USDA Library in San Francisco, and from the USDA Library in Washington, D. C. Also, some of the men working with herbicides were contacted for suggestions.

Table 1 lists the chemicals and Table 2 the formulations deemed most suitable for the game range restoration project. It should not be construed that these chemicals and formulations are considered to be the only chemicals or formulations. In some cases the selections are quite controversial from an economic standpoint or as to the selection of a particular brand or company formulation.

The following personnel aided in the formulation and selection of herbicides:

Industrial Agencies

Larry Bopp	General Dyestuff, San Francisco
Ivor Burden	United Chemical, Richmond
Hensel	California Spray Chemicals, Richmond
Chet Otis	Dow Chemical, San Francisco
R. N. Raynor	Dow Chemical, San Francisco
Otto Steinen	U. S. Rubber, Riverside
Dale Wolfe	DuPont, Wilmington, Delaware

State Agencies

Virgil Freed	Agricultural Experiment Station, Corvallis, Oregon
W. A. Harvey	University of California, Davis
O. A. Leonard	University of California, Davis

Federal Agencies

H. R. Offord	Bureau of Entomology and Plant Quarantine, Berkeley
Clarence Quick	Bureau of Entomology and Plant Quarantine, Berkeley
D. R. Cornelius	CF&RES
C. A. Graham	CF&RES

4. Details on Selected Herbicides

A. 2,4-D

The butyl ester of 2,4-D will be used as formulated by D. R. Cornelius, with which a 85-90 percent kill on big sagebrush was obtained. This low volume spray formulation has been tested on a large-scale basis with successful reduction of the sagebrush.

Hervey (Colorado Agricultural Extension Service) has also reported good results with the butyl ester on sagebrush as compared to other ester formulations. Other workers have reported greater success with the low volatile formulations than with the high volatile (of which butyl ester is an example). Still others maintain that the success is due directly to the amount of parent acid in the solution.

The use of 2,4-D will be tried for reduction of all broadleaved plants appearing on the four test areas.

B. 2,4,5-T

Propyl ester of 2,4,5-trichlorophenoxyacetic acid will be used as in the formulation of the high volume solution of 2,4-D. The purpose in use of this chemical will be the attempt to pick up any resistant broadleaved species of 2,4-D. The solution used appears to be essentially the same as that used by Cornelius, Leonard and others on sage, manzanita, chamise, and live oaks.

C. IPC

The emulsified N-phenyl isopropyl carbamate will be used at the rate of 6 lbs. per acre, to reduce the grasses on the test areas. The rate used was suggested by C. A. Graham, although Freed has reported 2 to 3 lbs. per acre adequate for pre-emergence control of cheatgrass and 3 to 5 lbs. per acre for post-emergence control. One of the factors to be considered in using this chemical is that the effectiveness is reduced as the ground temperature is increased due to the action of the soil micro-organism on the chemical on the ground.

D. IPC Cl

The chloro form of IPC will be applied at the same rate as IPC. This form will be used on the basis of Freed's publication (October, 1952) in which the application of 3 lbs. of the chloro IPC gave 98 percent control on weedy grasses against 70 to 85 percent control with use of IPC. In addition, the chloro IPC is relatively stable in the soil at warmer temperatures.

E. TCA

Trichloracetic acid will be used on the experimental area with a 90 percent composition of cheatgrass and mustard. TCA, like IPC, is reduced in effectiveness with the increase of ground temperature.

F. CMU

p-chlorophenyl dimethylurea was included at the suggestion of Dale Wolfe, DuPont representative. The chemical was furnished free of charge to the project since the application technique is untried.

The plan is to prepare a seedbed and plant bitterbrush in the fall at a depth of 1-1/2 inches, then spray the planted area with the three rates of chemical -- 3 lbs., 1-1/2 lbs. and 1/2 lb. per acre, with the hope that cheatgrass seed plowed under 1-1/2 inches will not germinate and the remaining cheatgrass seedlings will be killed by the chemical. The three rates of application are hoped to bracket the point where cheatgrass is killed and bitterbrush seedlings will survive.

CMU is normally used as a soil sterilant with application rates on occasion up to 100 lbs. per acre. The chemical becomes fixed in the soil at depths governed by the rainfall after application and the rate of application.

G. MH 30

Maleic hydrazide is still in the preliminary testing stage. The product has just been made commercially available (March, 1953). Field results with MH as a herbicide are quite variable, due possibly to heavy dew or rain occurring before the chemical is absorbed, or the omission of wetting agent in the spray formulation. Young plants have shown the greatest response from MH and treatment in later growth stages have shown little or no effect. Grasses are apparently the most susceptible for treatment with a formulation (from greenhouse data) of .5 percent to .25 percent as a herbicide; .1 to .05 percent as a growth inhibitor, and .025 percent to prevent pollen germination.

H. PCP Na

Sodium Pentachloraphenate (water soluble) is used as a contact weed killer. It appears to be most effective on annuals and non-sprouting species at dosage rates of from 4 to 6 lbs. per acre. Heavier applications are needed for more resistant species. Since this chemical herbicide is a contact killer, high volume solutions are required to insure good coverage of species sprayed. The usual recommendation is to dissolve the PCP in 100 gallons of an oil and water mixture for a 1-acre application. The oil-water mixture requires a spray rig with good mechanical agitation.

Table 1. -- Chemicals selected for use

Registrant and Product	Name and Percent of Active Ingredient	Percent of Active Ingredient	Lbs. Acid Per Gal.	Type of Chemical	Used for Control of	Mamalian Toxicity
California Spray Chem. Corp. Estercide T-2 weed and brush killer	Isopropyl ester of 2,4,5-T	28.40	2.00	Hormone	Broadleaved trees, shrubs, forbs	Not labeled poison (avoid breathing mist; avoid contact with eyes, skin, clothing).
Weed-Be-Gon #64	Alkanolamine salts of 2,4-D	60.50	4.00	Hormone	Broadleaved trees, shrubs, forbs	ditto
Naugatuck Chem. MH-30 Maleic hydrazide	Diethanolamine salt of 1,2-dihydropyridazine-3,6-dione	58.00	3.00	Hormone	Grasses	LD 50 oral on rats 2.2g/kg
United Chemical Penta weed killer anti-dusting	Na pentachlorophenate Salts of other chloro-phenols	50.00 8.66	Dry Dry	General contact	All vege-tation	Poison label dust and vapour mucous irritant; skin irritant above 1% concentration.
IPC 25% emulsifiable	Isopropyl-N-phenyl carbamate	25.00	2.00	Soil sterilant selective con-tact	Grasses	Not labeled poison (avoid breathing mist; avoid contact with eyes, skin, clothing).
Chloro IPC 47% emulsifiable	3-chloro isopropyl-N-phenyl carbamate	47.00	4.00	ditto	ditto	ditto
Dow Chemical Sodium TCA 90%	Sodium trichloracetates	90.00	-	ditto	ditto	ditto

Table 1. -- Chemicals selected for use (Cont.)

Registrant and Product	Name and Percent of Active Ingredient	Percent of Active Ingredient	Lbs. Acid Per Gal.	Type of Chemical	Used for Control of	Mammalian Toxicity
Thompson Chem. Corp. Ranchers butyl ester	Butyl ester 2,4-D	82.50	6.40	Hormone	Broadleaved trees, shrubs, forbs	Not labeled poison (avoid breathing mist; avoid contact with eyes, skin, clothing)
DuPont De Nemours DuPont 80% CMU weed killer	3-(p-chlorophenyl)-1, 1-dimethylurea	80.00	Dry	Soil sterilant	All vegetation	Acute oral toxicity to rats, LD 50 3.7g/kg.

Table 2. -- Formulation of herbicidal solutions

Name	Amt. Comm. Chem.	Oil	Water	Emulsifying Agent	Lbs. Chem. Per A.	Approx. Cost Per A.	Part or Whole Formulation Credit
2,4-D	40 oz.	1 gal. diesel	9 gal.	12 oz. Antrox A400	2	2.00	D. R. Cornelius
2,4-D	40 oz.	1 gal. diesel	39 gal.	12 oz. Antrox A400 2/	2	2.00	D. R. Cornelius
2,4,5-T	5 qt.	1 gal. diesel	28 gal.	12 oz. Antrox A400	3	9.50	O. A. Leonard
IPC	3 gal.	5 gal. 7R 1/	32 gal.	1 qt. B1956 3/	6	14.25	C. Graham V. Freed Hensel
IPC Cl	6 qt.	5 gal. 7R	33½ gal.	1 qt. B1956	6	17.60	C. Graham V. Freed Hensel
MH 30	10 qt.		40 gal.	3 oz. Dreft	8	40.00	E. B. Eskew O. Steinen
PCP (Na)	15 lbs.	20 gal. diesel	20 gal.		15	5.40	C. Otis
TCA	10 lbs.		40 gal.		9	4.30	O. A. Leonard Raynor
CMU	3 lbs.		40 gal.		3	9.00	D. Wolfe
CMU	1½ lbs.		40 gal.		1½	4.50	D. Wolfe
CMU	½ lb.		40 gal.		½	1.50	D. Wolfe

1/ 7R is a California Chem. Spray product containing 95% aromatic oil distillate.
2/ Antrox A400 is a General Dyestuff product (surface active agent) marketed under the name of IGEPAL CO-630 (Alkyl phenoxy polyoxyethylene ethanol)
3/ B1956 is a California Chem. Spray product (surface active agent).

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Game Range Restoration

CF&RES
R. L. Hubbard
April 21, 1953

METHODS AND SPECIFICATIONS

No. 8

Subject: Site factors: Colman soil moisture units - computation of soil moisture measurements

1. Check field figures as soon as possible to see if they are reasonable by comparison with previous readings.

2. Correct readings, both temperature and moisture, for meter differences. To do this, check the "Standardization of Meter" table at the bottom of Form CF&RES-221. If any of the readings differ more than 2 points from the standard, adjust the readings in that resistance range. There is no hard and fast rule for this adjustment and the person doing the computing must use his own judgment.

3. Correct the temperature readings for the differences in the thermistors. To do this, make a lay over template to fit Form CF&RES-221 (one for each stack). On this template ink the proper dial correction for each unit, determined by the thermistor coefficients (see Table 1).

   Add or subtract (as called for) these dial corrections to the reading corrected for meter. Record this figure in the column "corrected temp. dial" on CF&RES-221.

4. Adjust moisture dial readings for temperature. Jerry Horton has developed an "alignment chart" to do this rapidly. Lay a straight edge across the chart, intercepting the corrected temperature reading on the temperature scale and the corrected moisture reading on the moisture scale. Read the moisture index off the MI scale. This "MI" is the moisture dial reading corrected to 60° F.

c.4 BOP
RLH

Table 1 [1]

Correction in Temperature Dial Reading for Various Thermistor Coefficients

Thermistor Coefficient	Dial Correction
0.94	+2
0.95	+2
0.96	+2
0.97	+1
0.98	+1
0.99	0
1.00	0
1.01	0
1.02	-1
1.03	-1
1.04	-2
1.05	-2
1.06	-2
1.07	-3
1.08	-3
1.09	-4
1.10	-4

[1] This table was worked out by Jerry Horton and Lyle Reiman at Glendora.

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Game Range Restoration

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R. L. Hubbard
April 23, 1953

STUDY PROGRESS REPORT

Subject: Site factors - Testing and installing of Colman soil moisture units

1. Background

Purpose of installation -- To get information on the relationship of soil moisture, precipitation, and vegetative cover on the germination and establishment of browse seedlings on various sites. (See Annual Work Plan, 1952 and M&S No. 6 of April 27, 1953.)

Field work by R. L. Hubbard and B. O. Pearson.

2. Testing of the Soil Moisture Units

The units were tested at the San Dimas Experimental Forest in accordance with M&S No. 6.

Splicing of unit leads to 3-conductor cable was done in accordance with M&S No. 6.

3. Installation of Units

Stacks of 10 elements each (see attached table for depth placement) were set in the ground at four locations as follows:

Wells Meadow	Cultivated site
Doyle	Cultivated site
Flukey Spring	Cultivated site
Flukey Spring	Uncultivated site

A 5-inch hole was put down with a 5-inch Retzer soil auger. Each unit was placed vertically at the desired depth and the soil packed around the unit. The units were placed near the edge of the hole and rotated so that no unit falls directly above the one below. The leads were run out horizontally a few inches to prevent any tendency for water to be channeled directly to the unit.

The cables were buried in a trench about 1 foot deep and led out to a switch box 4 feet from the hole. The eight cables were run up through a 2-inch pipe and into the box where they were connected to a multiple pole switch. (See Table 1 for depth of units and other data on the four installations.)

4. Approximate Man-Hours Involved in the Various Steps

Testing (35 units) - 30
Splicing (35 units) - 48
Installation (1 stack) - 10

c.40 BOP PL4 Site

Table 1.---Depth, thermistor coefficient and test number* of units installed at four locations in Spring, 1953

Location		WELLS MEADOW (clear cultivated)		FLUKEY SPRING (clear cultivated)		FLUKEY SPRING (orig. vegetation)		DOYLE (clear cultivated)	
Dial No.	Depth (in.)	Test No.	Thermistor Coefficient	Test No.	Thermistor Coefficient	Test No.	Thermistor Coefficient	Test No.	Thermistor Coefficient
1	1½	8	1.02	11	1.05	31	1.07	21	.97
2	4½	10	1.02	18	1.06	9	1.06	35	.97
3	9	17	1.01	25	1.08	26	1.07	34	.93
4	15	4	1.00	30	1.08	13	1.08	3	.98
5	21	5	1.02	1	1.07	32	1.06	19	.99
6	30	14	1.01	29	1.06	7	1.05	6	.99
7	42	2	1.02	20	1.09	15	1.09	33	.99
8	54	12	1.02	27	1.06	23	1.07	28	1.00

* Numbers assigned to the units when tested at San Dimas Experimental Forest.

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April 24, 1953

METHODS AND SPECIFICATIONS

No. 6

Subject: Site factors - testing and installing Colman soil moisture units

1. Description of the Unit

The Colman soil moisture unit measures temperature and moisture in terms of electrical resistances. Each unit contains a moisture element and a temperature element. The moisture element is an electrode sandwich constructed with monel screen and silica fibered cloth. The temperature element is a disc type thermistor. The two elements are enclosed in a monel case which is 1 x 1.5 x .028 inches outside measurement.

Soil unit leads are led out from the thermistor end of the unit. These leads are colored as follows: white for the temperature element, red for the moisture element, and black for the lead common to the two.

2. Testing the Units

Test each unit throughout its electrical resistance range before installing it in the soil. To do this, take a brass ring 9 inches in diameter and 2 inches deep, faced on the bottom with brass window screen, and cover the bottom with blotter paper; fill the ring with screened soil and pack the soil to apparent field density.

Weigh the dry assembly (including the units) to the nearest gram. Then place the assembly in a pan containing distilled water until the soil is saturated.

Slit the soil open with a spatula in a number of places (15 to 20) and place a moisture unit vertically in each slit with the lead connection on top. Level the top of the unit with the top of the soil. Pack the soil lightly around the units so all parts are in contact with the soil.

Now place this assembly and a beaker containing a concentrated solution of lead nitrate in a bell jar humidity chamber for about 20 hours to allow the soil moisture to come to equilibrium.

c.to BOP, RLH

Remove the assembly from the humidity chamber, weigh it, and take both temperature and moisture readings (see M&S No. 7).

Allow the soil to dry for 8 to 24 hours - long enough for an appreciable change in the unit readings.

Replace the assembly in the humidity chamber and repeat the process until the soil has dried to about its initial weight.

3. Splicing the Unit Leads to the Cable

The units come equipped with 6-foot leads. Since these are not long enough to permit satisfactory installation, it is necessary to lengthen them by splicing them on to a length of 3 conductor cable.

After the units have been tested, twist the three leads together and cover them with flexitube. Flexitube is a vinylite type tubing that can be expanded in a solution containing three parts carbon tetrachloride and one part acetone. Thread the leads through the tubing while it is still expanded, using a blunt needle and string. Tape the junction of the leads to the moisture unit with No. 33 Scotch electrical tape.

Solder each lead wire of the moisture unit to its corresponding colored wire in the 3 conductor cable. Coat each soldered connection with black mastic and tape with No. 33 Scotch electrical tape. Bunch and tape the three splices together.

Place this splice in a 7/8" brass tube 9" long. Plug the cable end of the tube by wrapping the cable with friction tape. Then force black mastic into the tube with a grease gun, making sure that the tube is completely filled and that no air pockets remain. Plug the lead end with a rubber stopper.

4. Installing the Units

Dig a hole of the desired depth with a 5" Retzer soil auger. Place each unit vertically, with the lead end pointing towards the center of the hole, at the desired depth and pack soil around it, using soil taken from the hole at about the same depth. Place the units near the edge of the hole and rotate them so that no unit falls directly below the one above it. Run the leads out horizontally in the hole a few inches to prevent water from being channeled directly to the unit.

Lead the cables from the units upward to the top of the hole. After the hole has been filled to within about a foot of the surface, start bunching the leads on the side of the hole nearest to the switch box. After the top unit has been installed, dig a trench about 4' long and 1' deep to within 6" of the hole. Work the cables down into the trench

by scraping a narrow trench in the remaining 6 inches, being careful not to disturb the upper units. Run the cables horizontally 4 feet and then upwards to the switch box through a 2" pipe with an elbow on the lower end. Attach the switch box to the top end of the pipe. Solder the leads to their proper terminals on a multiple pole switch.

Cast a concrete footing around the base of this pipe to hold it upright.

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April 24, 1953

METHODS AND SPECIFICATIONS

No. 7

Subject: Site factors: soil moisture - reading and standardization of Colman soil moisture meter

1. Method of Reading

A. Switch "power" switch to "Fil" position. Let the meter warm up for about 30 seconds; then switch to "on" position.

B. Plug the male jacks on the meter cable into the same colored female jack on the switchboard.

C. Two readings are taken for each unit; one for temperature and one for soil moisture.

Assume readings are to be made first for soil moisture unit number 1. Turn dial to number 1 in switch box.

D. To obtain temperature readings:

Place the "element" switch on "T" and the "scale" switch on "LO". Adjust the meter needle to exactly 200 by turning the "adjust" switch. Depress the "read" button and read, always waiting until the needle has stopped drifting. Release the "read" button and check to make certain the needle returns to 200. Record the reading on Form CF&RES-221. Turn to the next unit by twisting the switch in the switch box clockwise to number 2. Read each unit in the installation in this manner.

E. To obtain moisture readings:

Place the "element" switch on "M". The "scale" switch should be on either the "HI" or "LO" scale; whichever permits a proper scale reading. When the needle falls below 50 on the "LO" scale, switch to "HI". When the reading on "HI" is above 180, switch to "LO." On borderline instances, record both "HI" and "LO" readings. Adjust the needle to 200 each time a switch is made from one scale to the other. A column for "HI" readings and one for "LO" readings is provided on Form CF&RES-221. Be certain to record the reading in the right column.

c. 4o BOP
RLH

2. General Information and Precautions to be taken in Handling Meter

A. A stand for the meter and a seat for the observer is provided at each installation. Place the meter on the stand and sit on the seat while taking the readings. The purpose of this is to insure the readings being taken from about the same position. Changes in the position of the meter or in the position of the observer have a marked effect upon the readings.

B. A consistent "drift" of the needle of more than 5 or 6 points generally indicates the need for new batteries.

C. The meter is a delicate instrument and should be treated as such. Carry it on the seat of the car when transporting it.

D. Fill out duplicate recording forms (one white and one blue). Keep the blue copy and send the white to Berkeley as soon after the readings are taken as possible.

3. Standardization of Meters

Considerable variation may exist between the reading obtained by one meter and those obtained by another. Since more than one meter will be used, it is necessary to have some method of standardization.

A "resistance board" will be provided with each meter. This board is a 4 x 5 inch piece of masonite with 7 carbon resistors mounted on it. Each of these resistors is tagged with the reading obtained with meter #115.

For the standardization readings, use only the black and red jacks. Plug these jacks into clips and clip on to the resistor posts.

Put the "element" switch on "M" and the "scale" switch on the scale called for on the tag for the particular resistor. Record both the standard readings and the actual readings in their proper place on Form CF&RES-221.

Make these readings either directly before or directly after reading the units.

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R. L. Hubbard
April 29, 1953

MONTHLY PROGRESS REPORT

April 1 to 30, 1953

Accomplishments:

1. Can plantings

The fruits of big sagebrush (Artemisia tridentata) and stratified bitterbrush (Purshia tridentata) seeds were planted in cans, such as were used in last fall's plantings, on the Doyle and Flukey Spring experimental areas on April 3 and March 27, respectively.

2. Tetramine treated bitterbrush seeds

Tetramine treated bitterbrush seeds were row planted. These exploratory plantings were designed to provide preliminary information on the effect of tetramine on the seed and the rodenticide and repellant properties of this chemical.

3. Stratified bitterbrush seed

Broadcast plantings of stratified bitterbrush seeds were made on 3' x 10' plots located on cultivated and unprepared seedbeds. These plots were covered by raking. These are exploratory plantings designed to provide information on the time of planting, effect of plant competition, on seed germination and survival.

4. Oldman wormwood (Artemisia abrotanum)

Row plantings of Oldman wormwood cuttings and rooted plants were made at Flukey Spring, Doyle, and Wells Meadow experimental areas to test species adaptability. This species was planted at the suggestion of Art Hensley, Del Fausett, and Hank Hjersman. The cuttings and rooted plants were made available by the Bishop Bureau of Land Management office by Virgil Bottini.

5. Multiflora rose and Russian wild olive

Row plantings of Multiflora rose and Russian wild olive rooted plants were made on the Doyle experimental area to test species adaptability. These plantings were made at the suggestion of James Blaisdell. The plants were made available to the project by Bert Knowles.

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RLH
file

6. Buffalo grass and Creeping alfalfa

Row plantings of Buffalo grass (Buchloe dactyloides) and Creeping alfalfa (spp.) seed were made at Flukey Spring to test species adaptability. These plantings were made at the suggestion of George Fischer, and the seed was also provided by him.

7. Siberian pea tree

Can plantings and row plantings of Siberian pea tree (Caragana arborescens) were made at Flukey Spring to test adaptability of the species. These plantings were made at the suggestion of Dr. R. Merton Love, who also made the seed available to the project.

8. Installation

The fourth and final soil moisture elements were installed on the Doyle area.

9. Germination

The 3-year old (or more) seed of Siberian pea tree was sampled for viability. Ninety percent of the seed germinated with moisture treatment.

10. Equipment

Fabricated Metals Corp. notified the project that their requisition on the spray rig dated February 27, 1953 had reached the Manufacturer's office April 24, 1953.

11. Study reports prepared

Seed germination

12. Methods and specifications prepared

Site factors; soil moisture - reading and standardization of Colman soil moisture meter #7.

Site factors - Colman soil moisture units - computation of soil moisture measurements #8.

Site factors - testing and installing Colman soil moisture units #6.

Instructions for setting up servicing and reading site factor instruments and gages.

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B. O. Pearson
April 29, 1953

MONTHLY PROGRESS REPORT

April 1 to 30, 1953

(See report by R. L. Hubbard)

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A. L. Hormay
April 30, 1953

METHODS AND SPECIFICATIONS

No. 9

Subject: Designations and markers for plots and other study units

Designation of plots and subplots

Plots — Number consecutively starting with 1. Start a new series of plot numbers on each experimental area.

Subplots — Letter and number by degree of breakdown.

The first degree subplot is the first subdivision of the plot. The second degree subplot is the first subdivision of the first degree subplot, and so on.

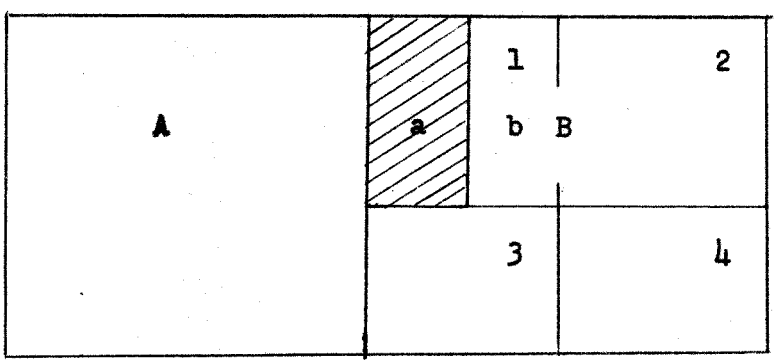
Therefore:

First degree subplot = A, B, C etc.
Second degree subplot = 1, 2, 3 etc.
Third degree subplot = a, b, c etc.

Examples of plot and subplot designations:

Flukey Spring 22 B 1 a = hatched area

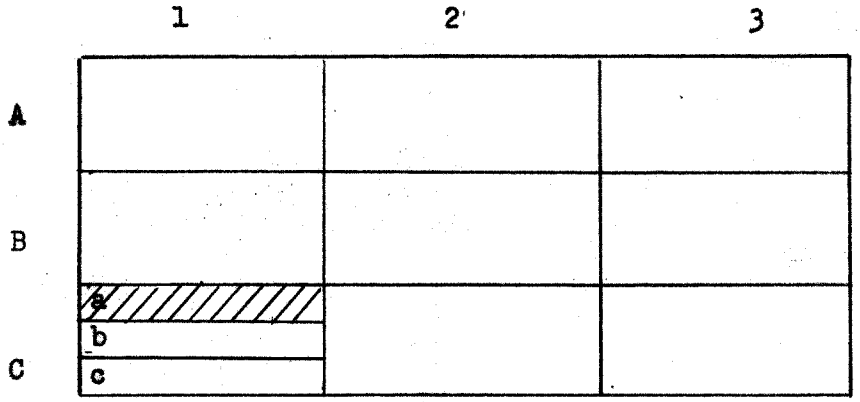
Plot No. 22



c.4o BOP
RmH

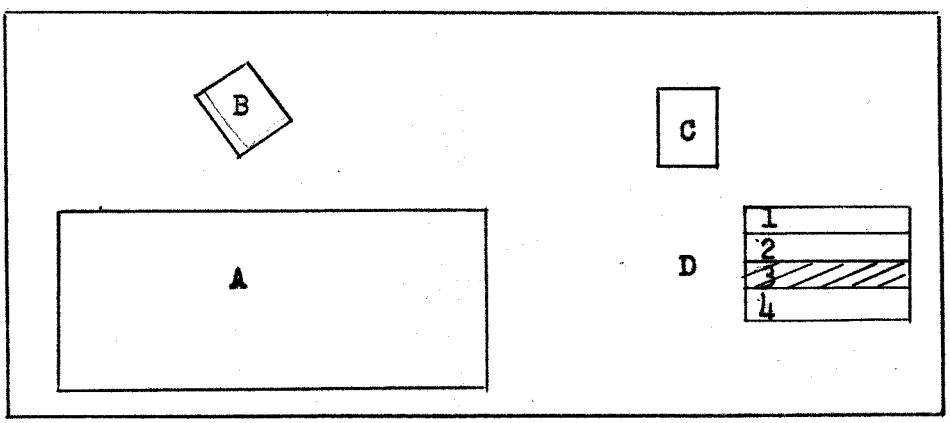
Casuse Mt. 1 C 1 a = hatched area

Plot No. 1



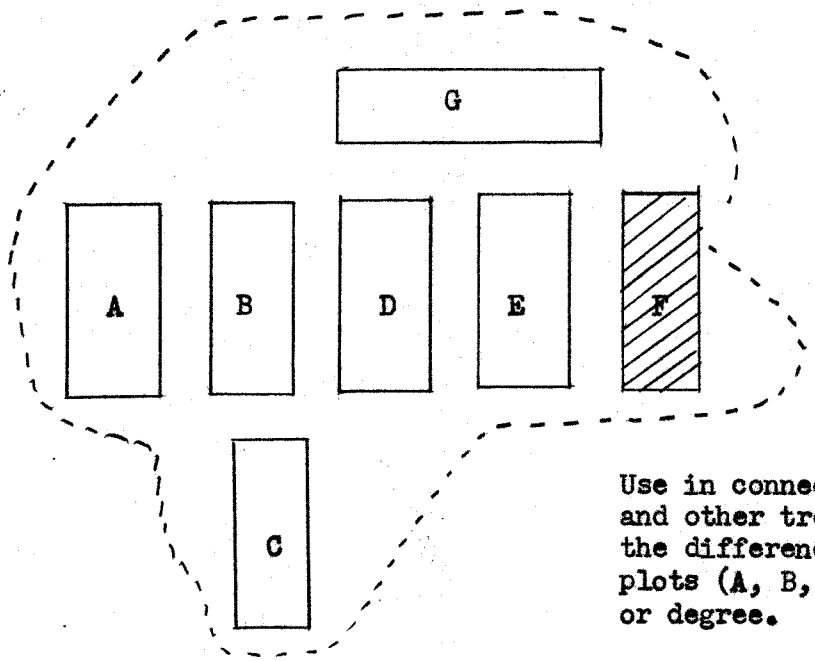
Flukey Spring 8 D 3 = hatched area

Plot No. 8



Doyle 2 F = hatched area

Plot No. 2 (area inside dotted line)

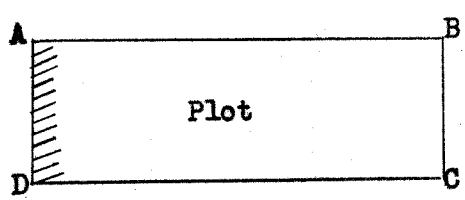


Use in connection with spray and other treatments where the difference between sub-plots (A, B, C etc) is time or degree.

Character of Study Unit Markers and Method of Marking

Study Unit	Character of Marker: Type	Color	Height: Over all	Height: Above ground	Position of spade	Method of marking
Plot 1/						
Key corner	Steel fence post	Orange	7'	5'	up	stencil
Other corners	" " "	"	"	"	down	none
Subplot						
Key corner	" " "	"	5'	3'	up	stencil
Other corners	" " "	"	"	"	down	none
Transects						
Head end	" " "	(Aluminum, (top 12"	7'	5'	up	stencil
Tail end	" " "	(orange	"	"	down	none
Intermediate points	5/8" steel peg	Orange	12"	1"	-	hand paint
Quadrat						
Key corner	" " "	"	"	"	-	" "
Other corners	" " "	(Orange, (top 1/2" (aluminum	"	"	-	none
Phenology plants						
All	3/4" x 1½" wood stakes topped with metal marking strip holder	Natural wood	18"	6"	-	hand paint or stencil
Camera hub	Steel fence post	Yellow, top 12" orange	5'	3'	up	stencil
Directional stake	" " "	6" yellow, orange stripes	5'	3'	down	handpaint or none

1/ Key corner always position A with respect to head end of plot in following diagram.



A D = head end

A = key corner

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CF&RES
A. L. Hormay
(11-24-52)
4-30-53

ORGANIZATION PLAN NO. 1

(Revised)

Research Responsibilities and Procedures

Division of Responsibility

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

Responsibility for planning beyond the general plans mentioned above and for carrying out and reporting on the work will be divided between B. O. Pearson and R. L. Hubbard as follows:

Subject-matter responsibility 1/

B. O. Pearson

A. Species

Stock

Develop machinery and equipment for collecting, cleaning, handling and storing seed and other planting stock for use in planting work.

B. Site preparation and maintenance

Mechanical
*Chemical
Fire
Grazing
Biological

Conduct the background research and develop practical methods, materials and equipment for effective site and seedbed preparation and maintenance.

1/ See Organization Plan No. 2, March 3, 1953, for breakdown of the subject-matter covered in this project.

* Phases of these subjects to be handled ultimately by a third technician who will work mainly on laboratory and greenhouse phases of the problem.

c. to BOP, RLH, file

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W46R-1
Game Range Restoration

CF&RES
R. L. Hubbard
5-1-53

METHODS AND SPECIFICATIONS

No. 10

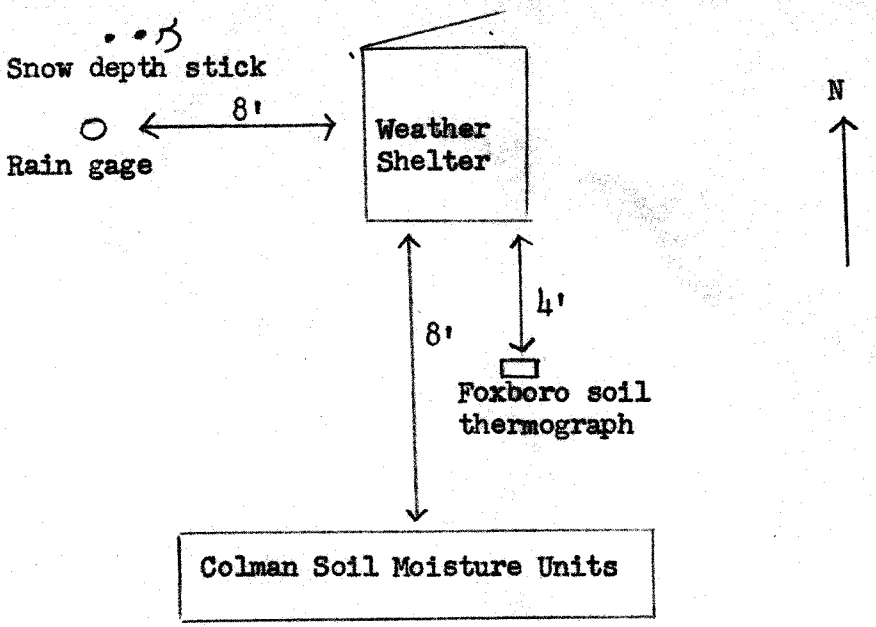
Subject: Site factors - installation of site factor measuring instruments on experimental areas

A. Instruments and date of installation

Factor and Instrument	Experimental Areas					
	Flukey Spring		Doyle		Wells Meadow	
		Date of instal.		Date of instal.		Date of instal.
Air Temperature						
1. Hygrothermograph	X		X		X	
2. Max. thermometer	X		X		X	
3. Min. thermometer	X		X		X	
Soil Temperature						
1. Foxboro soil thermograph	X		X		X	
2. Colman soil moisture units	X	3-24-53	X	4-2-53	X	3-18-53
Precipitation						
1. Rain gage	X		X		X	
2. Snow gage	X		X		X	
Soil moisture	X	3-24-53	X	4-2-53	X	3-18-53

c.40 BOP Ref

B. General arrangement of instruments and equipment at site factor stations



Records to be Taken and Schedule

Factor and Instrument	Comments	Schedule
Air Temperature		
1. Hygrothermograph	Humidity element will not be operated	Replace chart each Monday at 8 A.M. PST at intervals to check thermograph
2. Maximum thermometer		"
3. Minimum thermometer		"
Soil Temperature		
1. Foxboro soil thermograph		Replace chart each Monday at 8 A.M. PST.
Precipitation		
1. Rain gage	Operate without funnel head from 10/31 to 5/1	Check after each storm
2. Snow gage		Check at weekly intervals and after each storm
Soil Moisture		
1. Colman soil moisture units	See M&S No. 7	Take readings preceding and after each storm depending on size as follows: Storm size — Days of reading Less than 0.50" - 1, 8, etc. 0.50 to 1.50" - 1, 3, 10, etc. More than 1.50" - 1, 2, 3, 5, 12, etc.

RR
COOPERATION
State of California
Department of Fish and Game
Project W46R-1
Game Range Restoration

A. L. Hormay
May 1, 1953

JOB PLAN

May 1 to July 1, 1953

Berkeley

1. Equipment and materials

   Prepare list and specification for items needed or that should be ordered this fiscal year.

2. Line up and obtain as many of the following weather instruments as possible:

No.	Item
3	Instrument shelter
3	Hygrothermographs
3 sets	Max-min thermometer
3	Holders Max-Min-thermometers
3	Rain gages complete with stands
3	Foxboro thermographs

3. Submit all plans for field work contemplated before work is undertaken.

4. Prepare experimental area and plot sketch diagrams showing location of plots and subplots. Number each unit that is already established according to M&S No. 9.

5. Check to make sure all forms, charts, and other equipment needed to carry out field work are on hand or forthcoming.

Cameras	Tatums
Film	Stencils
Tape	Markers (Tacks)
Compass	Stakes
Rulers	Pencils

Field (approx. chronological)

A. Doyle

1. Check screens on planting cans.

2. Gather together left-over materials and equipment.

3. Remove wire mesh from gates.

c. to BoD, RLH

4. Mark phenology plants - take record.

5. Make record seedling germination-survival "can" and other plantings (including large plots).

6. Locate spray, cultivation, and burning plots.

7. If possible get disc terracer and other equipment at Blacks Mt. enroute Dry Lake.

B. Casuse Mt. and Flukey Spring

1. As for Doyle above omitting 3.

2. Plant bitterbrush seed in blocks or rows comparable to earlier plantings made this spring.

3. Plan treatment and measurement procedure for large plot plantings on the ground.

4. Lay out and measure treatment plots (spray, cultivation, burn).

5. Settle photograph procedure.

6. Dig up seedlings and note root development - length, etc. - in cans on large plots.

7. Training school Doyle - Hubbard (Pearson?).

8. Prepare equipment, get set-up, etc. spray work - Pearson (Modoc personnel).

9. Plan signs for various experimental areas and plots.

10. Obtain and set up weather instruments on the Flukey Spring, Doyle, and Wells Meadow experimental areas.

RR-CAL
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State of California
Department of Fish and Game
Project W-6R-1
Game Range Restoration

CF&RES
May 4, 1953

JOB PLAN

May 1 to 31, 1953

Objectives:

1. Locate plots to be sprayed, plowed or burned this spring on the three experimental areas and start plot treatments.

2. Make first systematic examination of plantings made last fall and this spring for seedling emergence and survival.

3. Start systematic soil moisture measurements.

4. Set up weather instruments - hygrothermograph, max-min thermometers and rain gage - on each experimental area.

5. Start systematic plant growth and development records.

c.40 Fish & Game
BDP
8/4

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W46R-1
Game Range Restoration

CF&RES
R. L. Hubbard
May 11, 1953

METHODS AND SPECIFICATIONS

No. 11

Subject: Site factors - instructions for installing, servicing and reading site factor instruments

I. Air Temperature

A. Hygrothermograph

1. Description

This instrument produces a continuous 7-day record of temperature and relative humidity. The thermal unit consists of an alcohol filled Bourdon tube which bends with changes in temperature. This action is transmitted by a system of levers to the pen which traces the temperature record on the chart.

The humidity unit consists of a set of human hairs which expand and contract with changes in moisture in the air. These changes in length of the hairs are transmitted by a system of levers to the pen which traces a record on the chart.

2. Installation

The hygrothermograph is set inside the frame on the floor of the weather shelter.

3. Servicing

The record chart is changed at the end of 7 days. To do this, lift the temperature and humidity pens from the chart with the lever on the front of the base and remove the clock-drum from the shaft on which it turns; pull out the spring clip holding the chart in place. Wind the clock and place the new chart so its lower edge rests on the projecting rim of the drum. Replace the drum on the shaft and lower it gently until the gears at the bottom interlock. Fill the recording pens with ink every time the chart is changed. To set the pens on the proper time line on the chart, turn the clock-drum counter clockwise to the desired position while the gears are meshed.

There are two adjustment nuts located near the humidity hair element. The front nut regulates the setting of the temperature pen.

The rear adjustment screw regulates the humidity pen setting. To adjust this pen for maximum upward swing, brush the hairs with a camel's hair brush dipped in distilled water for about 5 minutes or until saturated and set the pen to read 92 percent relative humidity. For minimum downward swing, set the hygrograph to indicate correct humidity during a period of low humidity after checking at least three times against psychrometer determinations.

Clean both the Bourdon tube and the hairs frequently by brushing them with a camel's hair brush. If the hairs become dirty, wash them with alcohol or ether.

Check the maximum and minimum recorded on the hygrothermograph with the maximum-minimum thermometers whenever possible. Use different hygrothermograph charts in summer and winter. When summer charts are replaced with winter charts or vice-versa, raise or lower the pen 30° with the adjustment screw.

4. Records

Record the exact time the chart is put on and taken off the drum.

B. Maximum-minimum thermometers

1. Description

The maximum thermometer is similar to a common mercury thermometer but it has a constriction in the column just above the mercury bulb. As the temperature rises the mercury in the bulb expands and is forced past the constriction. The mercury is held at its maximum height by this constriction until it is shaken down by centrifical force.

The minimum thermometer is an alcohol thermometer. It has a rider in the alcohol column. The meniscus at the top of the alcohol column carries the rider downward as the temperature decreases. The rider is left behind as the temperature rises to mark the minimum point.

2. Installation

Both thermometers are mounted horizontally in a special (Townsend) support. In this mount the bulb on the maximum thermometer lies slightly above horizontal and the bulb of the minimum thermometer a little below horizontal.

3. Servicing

(a) If the mercury column in the maximum thermometer separates, reunite it by gently tapping the bulb end of the metal thermometer frame on some soft but solid object or snap the bulb downward by hand. Be careful not to snap or to swing the thermometer too vigorously unless some of the mercury rests against the constriction.

(b) If the alcohol column of the minimum thermometer becomes separated and the rider is immobilized, tap the bulb end of the metal thermometer frame against some soft solid object while the thermometer is held upright, or strike the top of the thermometer frame against the hand with the bulb end held in the other hand. If these methods don't work, snap the thermometer downward with the bulb end down or slowly warm the alcohol bulb with a match so as to force all the bubbles to the top end; leave the thermometer in an upright position until all of the alcohol vapour condenses and runs down the column.

4. Records

To read the maximum thermometer, disengage the pawl or pen from the rotor on the thermometer holder and lower the mercury end to a resting position. The maximum temperature is indicated at the top of the mercury column. Read to the nearest one-half degree. Then whirl the thermometer until the mercury column indicates the current temperature. Reset the thermometer in the holder.

Read the minimum thermometer while it is still locked horizontally in the holder. Read the end of the rider farthest from the bulb. After reading, tip the bulb end upward so the rider comes to rest on the alcohol meniscus. Then reset in holder.

Record maximum and minimum temperature reading on a standard Weather Bureau form.

II. Soil Temperature

A. Foxboro thermograph

1. Description

This instrument produces a continuous 7-day record of soil temperature. The thermal unit consists of a bulb at the end of a 10-foot, small bore cable-protected tube. The amplifying timing and recording mechanism is housed in a circular metal case with a glass face.

2. Installation

This instrument is mounted vertically on the back wall of the weather shelter. In the present study the bulb will be buried 3/4" in the soil and the connecting cable will be led about 6" underground to a point below the shelter.

3. Servicing

Change the record chart at 7-day intervals. To remove the chart lift off the pen; then press down the button in the center knob and lift up the knob. Remove the chart. Wind the clock with the key hung in the weather shelter and push the "start" switch counter clockwise. Put on a new chart; set it on proper time. Replace

the center knob. Fill the pen with ink and lower it on to the graph.

Check the instrument against a reliable thermometer to determine whether indicated temperatures are too high or too low or whether the total range is too great or too small. To do this, immerse the thermograph bulb and the thermometer in water baths between 40° and 200° F. Use the small set screw at the base of the pen to set the pen on the proper temperature. To increase or decrease the range of the instrument, take off the metal face and adjust the small set screw below the pen arm.

4. Records

On the back of the chart record the exact time the chart is put on and taken off.

III. Precipitation

A. Standard 8" rain gage

1. Description

This gage consists of two cylindrical containers, one inside the other. The cross-sectioned area of the top of the outer cylinder is ten times the cross-sectional area of the top of the inner. The outer cylinder is fitted with a funnel receiver which directs the flow of water to the inner cylinder. The assembly is supported by a three-legged metal stand.

2. Installation

The stand is secured by bolting the legs to stakes driven in the ground. The top of the stand is set level.

3. Servicing

During the snow season, remove the funnelhead and inner cylinder. This leaves only the outer cylinder. Put .02" of light transformer oil in the gage each measurement to prevent evaporation of moisture.

4. Records

To measure precipitation while the head and inner core are in place insert the rule provided to the bottom of the inner cylinder. Hold it there for a second or two and then withdraw and read it. The scale is graduated to read directly.

When the 8" funnelhead and inner cylinder are not used, pour the water collected in the 8" cylinder into the graduate provided. Read the bottom of the meniscus. Empty the cylinder, add .02" of light transformer oil. If the water is frozen, thaw out gently to minimize evaporation.

Record precipitation figures on standard Weather Bureau form.

B. Snow depth gage

This is simply a post 1" x 4" x 6' set 2' into the ground. The 4' remaining out of the ground is marked in feet and inches.

Snow depth is read directly off the post. Record on standard Weather Bureau form.

IV. Soil Moisture

A. Testing and installing Colman soil moisture units

1. Description of the unit

The Colman soil moisture unit measures temperature and moisture in terms of electrical resistances. Each unit contains a moisture element and a temperature element. The moisture element is an electrode sandwich constructed with monel screen and silica fibered cloth. The temperature element is a disc type thermistor. The two elements are enclosed in a monel case which is 1 x 1.5 x .028 inches outside measurement.

Soil unit leads are led out from the thermistor end of the unit. These leads are colored as follows: white for the temperature element, red for the moisture element, and black for the lead common to the two.

2. Testing the units

Test each unit throughout its electrical resistance range before installing it in the soil. To do this, take a brass ring 9" in diameter and 2" deep, faced on the bottom with brass window screen, and cover the bottom with blotter paper; fill the ring with screened soil and pack the soil to apparent field density.

Weigh the dry assembly (including the units) to the nearest gram. Then place the assembly in a pan containing distilled water until the soil is saturated.

Slit the soil open with a spatula in a number of places (15 to 20) and place a moisture unit vertically in each slit with the lead connection on top. Level the top of the unit with the top of the soil. Pack the soil lightly around the units so all parts are in contact with the soil.

Now place this assembly and a beaker containing a concentrated solution of lead nitrate in a bell jar humidity chamber for about 20 hours to allow the soil moisture to come to equilibrium.

Remove the assembly from the humidity chamber, weigh it, and take both temperature and moisture readings.

Allow the soil to dry for 8 to 24 hours - long enough for an appreciable change in the unit readings.

Replace the assembly in the humidity chamber and repeat the process until the soil has dried to about its initial weight.

3. Splicing the unit leads to the cable

The units come equipped with 6' leads. Since these are not long enough to permit satisfactory installation, it is necessary to lengthen them by splicing them on to a length of 3 conductor cable.

After the units have been tested, twist the three leads together and cover them with flexitube. Flexitube is a vinylite type tubing that can be expanded in a solution containing three parts carbon tetrachloride and one part acetone. Thread the leads through the tubing while it is still expanded, using a blunt needle and string. Tape the junction of the leads to the moisture unit with No. 33 Scotch electrical tape.

Solder each lead wire of the moisture unit to its corresponding colored wire in the 3 conductor cable. Coat each soldered connection with black mastic and tape with No. 33 Scotch electrical tape. Bunch and tape the three splices together.

Place this splice in a 7/8" brass tube 9" long. Plug the cable end of the tube by wrapping the cable with friction tape. Then force black mastic into the tube with a grease gun, making sure that the tube is completely filled and that no air pockets remain. Plug the lead end with a rubber stopper.

4. Installing the units

Dig a hole of the desired depth with a 5" Retzer soil auger. Place each unit vertically, with the lead end pointing towards the center of the hole, at the desired depth and pack soil around it, using soil taken from the hole at about the same depth. Place the units near the edge of the hole and rotate them so that no unit falls directly below the one above it. Run the leads out horizontally in the hole a few inches to prevent water from being channeled directly to the unit.

Lead the cables from the units upward to the top of the hole. After the hole has been filled to within about a foot of the surface, start bunching the leads on the side of the hole nearest to the switch box. After the top unit has been installed, dig a trench about 4' long and 1' deep to within 6" of the hole. Work the cables down into the trench by scraping a narrow trench in the remaining 6", being careful not to disturb the upper units. Run the cables horizontally 4' and then upwards to the switch box through a 2" pipe with an elbow on the lower end. Attach the switch box to the top end of the pipe. Solder the leads to their proper terminals on a multiple pole switch.

Cast a concrete footing around the base of this pipe to hold it upright.

B. Reading and standardization of Colman soil moisture meter

1. Method of reading

(a) Switch "power" switch to "Fil" position. Let the meter warm up for about 30 seconds; then switch to "On" position.

(b) Plug the male jacks on the meter cable into the same colored female jack on the switchboard.

(c) Two readings are taken for each unit; one for temperature and one for soil moisture.

Assume readings are to be made first for soil moisture unit number 1. Turn dial to number 1 in switch box.

(d) To obtain temperature readings:

Place the "element" switch on "T" and the "scale" switch on "LO". Adjust the meter needle to exactly 200 by turning the "adjust" switch. Depress the "read" button and read, always waiting until the needle has stopped drifting. Release the "read" button and check to make certain the needle returns to 200. Record the reading on Form CF&RES-221. Turn to the next unit by twisting the switch in the switch box clockwise to number 2. Read each unit in the installation in this manner.

(e) To obtain moisture readings:

Place the "element" switch on "M". The "scale" switch should be on either the "HI" or "LO" scale; whichever permits a proper scale reading. When the needle falls below 50 on the "LO" scale, switch to "HI". When the reading on "HI" is above 180, switch to "LO". On borderline instances, record both "HI" and "LO" readings. Adjust the needle to 200 each time a switch is made from one scale to the other. A column for "HI" readings and one for "LO" readings is provided on Form CF&RES-221. Be certain to record the reading in the right column.

2. General information and precautions to be taken in handling meter

(a) A stand for the meter and a seat for the observer is provided at each installation. Place the meter on the stand and sit on the seat while taking the readings. The purpose of this is to insure the readings being taken from about the same position. Changes in the position of the meter or in the position of the observer have a marked effect upon the readings.

(b) A consistent "drift" of the needle of more than 5 or 6 points generally indicates the need for new batteries.

(c) The meter is a delicate instrument and should be treated as such. Carry it on the seat of the car when transporting it.

(d) Fill out duplicate recording forms (one white and one blue). Keep the blue copy and send the white to Berkeley as soon after the readings are taken as possible.

3. Standardization of meters

Considerable variation may exist between the reading obtained by one meter and those obtained by another. Since more than one meter will be used, it is necessary to have some method of standardization.

A "resistance board" will be provided with each meter. This board is a 4 x 5" piece of masonite with 7 carbon resistors mounted on it. Each of these resistors is tagged with the reading obtained with meter #115.

For the standardization readings, use only the black and red jacks. Plug these jacks into clips and clip on to the resistor posts.

Put the "element" switch on "M" and the "scale" switch on the scale called for on the tag for the particular resistor. Record both the standard readings and the actual readings in their proper place on Form CF&RES-221.

Make these readings either directly before or directly after reading the units.

C. Colman soil moisture units - computation of soil moisture measurements

1. Check field figures as soon as possible to see if they are reasonable by comparison with previous readings.

2. Correct readings, both temperature and moisture, for meter differences. To do this, check the "Standardization of Meter" table at the bottom of Form CF&RES-221. If any of the readings differ more than 2 points from the standard, adjust the readings in that resistance range. There is no hard and fast rule for this adjustment and the person doing the computing must use his own judgment.

3. Correct the temperature readings for the differences in the thermistors. To do this, make a lay over template to fit Form CF&RES-221 (one for each stack). On this template ink the proper dial correction for each unit, determined by the thermistor coefficients (see Table 1).

Add or subtract (as called for) these dial corrections to the reading corrected for meter. Record this figure in the column "corrected temp. dial" on CF&RES-221.

4. Adjust moisture dial readings for temperature. Jerry Horton has developed an "alignment chart" to do this rapidly. Lay a straight edge across the chart, intercepting the corrected temperature reading on the temperature scale and the corrected moisture reading on the moisture scale. Read the moisture index off the MI scale. This "MI" is the moisture dial reading corrected to 60° F.

Table 1 1/

Correction in Temperature Dial Reading for Various Thermistor Coefficients

Thermistor Coefficient	Dial Correction
0.94	+2
0.95	+2
0.96	+2
0.97	+1
0.98	+1
0.99	0
1.00	0
1.01	0
1.02	-1
1.03	-1
1.04	-2
1.05	-2
1.06	-2
1.07	-3
1.08	-3
1.09	-4
1.10	-4

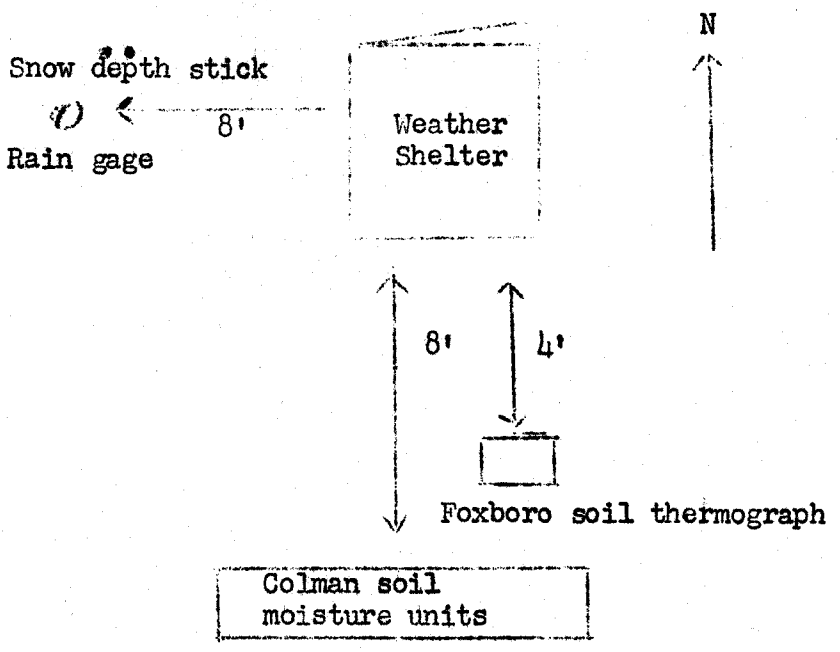
1/ This table was worked out by Jerry Horton and Lyle Reiman at Glendora, California.

D. Installation of site factor measuring instruments on experimental areas

1. Instruments and date of installation

Factor and Instrument	Experimental Areas: Flukey Spring		Doyle		Wells Meadow	
		Date of instal.		Date of instal.		Date of instal.
Air Temperature						
1. Hygrothermograph	X		X		X	
2. Max. thermometer	X		X		X	
3. Min. thermometer	X		X		X	
Soil Temperature						
1. Foxboro soil thermograph	X		X		X	
2. Colman soil moisture units	X	3-24-53	X	4-2-53	X	3-18-53
Precipitation						
1. Rain gage	X		X		X	
2. Snow gage	X		X		X	
Soil Moisture	X	3-24-53	X	4-2-53	X	3-18-53

2. General arrangement of instruments and equipment at site factor stations



Records to be Taken and Schedule

Factor and Instrument	Comments	Schedule
Air Temperature		
1. Hygrothermograph	Humidity element will not be operated.	Replace chart each Monday at 8 A.M. PST at intervals to check thermograph.
2. Maximum thermometer		"
3. Minimum thermometer		"
Soil Temperature		
1. Foxboro soil thermograph		Replace chart each Monday at 8 A.M. PST.
Precipitation		
1. Rain gage	Operate without funnelhead from 10/31 to 5/1.	Check after each storm.
2. Snow gage		Check at weekly intervals and after each storm
Soil Moisture		
1. Colman soil moisture units	(See pages 7 and 8)	Take readings preceding and after each storm depending on size, as follows: Storm size — Days of reading Less than 0.50" - 1, 8, etc. 0.50 to 1.50" - 1, 3, 10, etc. More than 1.50" - 1, 2, 3, 5, 12, etc.

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STATE California

PROJECT NO. W-46R-2

Contract No. 14-19-008-1661

FEDERAL AID IN WILDLIFE RESTORATION

PLANS, SPECIFICATIONS AND ESTIMATES

INVESTIGATIONS

DATE May 12, 1953

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 William P. Dasmann, Senior Game Biologist, Game Management Branch, California Department of Fish and Game

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

4. Summary of Accomplishments During Fiscal Year 1953 (July 1, 1952 to June 30, 1953):

The first year's effort was devoted mainly to planning and organizing the project, training personnel, and starting experimental work both in the field and in the laboratory. The initial work was exploratory, designed to provide information on various aspects of the over-all problem to serve as a guide for more pointed and intensive studies.

Following reconnaissance field surveys, four experimental areas were established on widely different sites in the problem area. A

deer-livestock exclosure and instruments for measuring soil moisture were set up on three to provide locations for detailed, systematic studies of these areas. Systematic measurements of soil moisture and growth and development of species important to the project were started. Controlled plantings of 13 shrubs, 2 forbs and 1 grass were made inside and outside the exclosures both in the fall and spring to provide leading information on seed germination and seedling growth and mortality in relation to such factors as weather, soil type, soil moisture, site preparation, time, rate, and depth of planting, grazing (by deer and livestock), and pests like rodents, birds and insects. Planting methods like drilling and broadcasting were tried on a few plots.

Other plots were treated to test the effectiveness of cultivation, chemical spraying and burning in preparing sites for planting.

A shrub nursery for testing the site adaptability of introduced species and for supplying life history information on species important to the broad project was set up on the most favorable experimental area.

In the laboratory a preliminary screening seed-germination test was undertaken with 13 shrub species. A few species germinated readily under normal germination temperatures but others remained dormant or were non-viable.

The results of most of these initial tests cannot be evaluated in any dependable way until the first growing season is completed -- in late summer, 1953. However, indications of results will be reported as they show up.

5. Work Plan for Fiscal Year 1954 (July 1, 1953 to June 30, 1954):

The work during the year will be guided to a considerable degree by the responses obtained in the tests to date. Particular emphasis will be placed on (1) developing effective methods of site preparation that will afford most favorable conditions for seedling establishment; and (2) working on seed germination problems, in both field and laboratory. The work program outlined under four headings covering the subject-matter field of this project (see third Quarterly Progress Report) follows:

A. Stock

(1) Collect, purchase, or in other ways acquire seed for experimentation. Seeds of the following native species are particularly needed.

Species	Common Name	Form
Ceanothus cuneatus	Wedgeleaf ceanothus	
Ceanothus greggii	Gregg ceanothus	
Ceanothus integerrimus	Deerbrush	
Ceanothus velutinus	Tobacco brush	
Cercocarpus betuloides	Birchleaf mahogany	

Species	Common Name	Form
Cercocarpus ledifolius	Curl-leaf mahogany	
Cowania mexicana var. stansburiana	Cliff rose	
Garrya fremontii	Fremont silk tassel	
Peraphyllum ramosissimum	Squawapple	
Prunus emarginatus	Bitter cherry	
Purshia tridentata	Bitterbrush	Non-sprouting form
Purshia tridentata	Bitterbrush	Sprouting form

(2) Acquire seedlings and cuttings for nursery and plot work. In particular get sprouting forms of bitterbrush, for adaptation trials under California conditions.

(3) Germination

Expand seed germination studies in the laboratory as outlined in the third Quarterly Progress Report.

(4) Growth and reproduction

Continue gathering systematic records of plant growth and development of important species on the various experimental areas.

(5) Pests and diseases

Continue observations of the planting can setups (see second Quarterly Progress Report) for evidence of damage to seed or seedlings by pests. Where damage is evident, determine cause, weigh the seriousness of problem, and search for clues to its solution or minimizing.

B. Site factors

(1) Weather

Obtain information on the influence of precipitation on the establishment of bitterbrush (and other species if possible) in the general vicinity of the experimental area. Analyze Weather Bureau records and ring counts from stem sections of the plants for date of reproduction establishment and indications of the nature of years favorable for growth of established plants.

(2) Soil moisture

Continue systematic measurement of soil moisture at the various stations.

Design a study to determine the amount of moisture needed in the soil during the season to insure seed germination and seedling establishment of various desirable deer browse species. In this

study water will be applied artificially in different amounts to different plots during the natural precipitation period. This study will greatly shorten the time needed to get the information called for in the first sentence. Successful revegetation of browse species, on the drier ranges especially, is heavily dependent on a clear understanding of soil moisture and its relation to site preparation, planting time and planting methods.

(3) Weather

Install rain gages, evaporation pans and temperature recording instruments at two soil moisture stations to establish relationship between weather factors and soil moisture.

C. Site preparation and maintenance

Continue mechanical, chemical and burning treatments on plots following through on the first year's work and modifying the tests as indicated by the initial reactions (see second and fourth quarterly reports for initial treatments).

D. Planting methods

Continue gathering information from various plots on time, depth and rating of planting that give the most successful and practicable results. (See second and fourth quarterly reports for planting methods used on various plots.)

6. The work outlined in paragraph 5 above will be carried out by the California Forest and Range Experiment Station through a cooperative agreement. A conformed copy of this agreement will be submitted when it has been duly executed. The following tabulation indicates the approximate manner in which the contractual budget item of paragraph 7 which follows is to be broken down.

Salaries

M. W. Talbot	$ None	
A. L. Hormay	2,200.00	
B. O. Pearson	4,290.00	
R. L. Hubbard	4,010.00	
Project assistant (to be appointed) GS-5	3,410.00	
Stenographer, GS-4 (1/4 time)	1,000.00	
Labor	3,900.00	
Total		$ 18,810.00

Service and expense		Total carried forward	18,810.00
Travel	3,840.00		
Automobile rental	2,360.00		
Equipment rental	1,125.00		
Total			7,325.00
Materials and supplies			
Fencing, stakes, and other plot materials	2,000.00		
Chemicals	300.00		
Laboratory supplies	200.00		
Film and processing	200.00		
Telephone and telegraph	100.00		
Miscellaneous	65.00		
Total			2,865.00
Total Cooperative Agreement			$29,000.00

7. Estimated expenditures, July 1, 1953 to June 30, 1954:

Service and expense		
Contractual services with the California Forest and Range Experiment Station	$29,000.00	
Pro-rata administrative charges	300.00	
Total Service and Expense		$29,300.00
Property and equipment		
2 Soil moisture meters	350.00	
1 Disc terracer for Ford-Ferguson Tractor	170.00	
Miscellaneous	100.00	
Total Property and Equipment		620.00
Total All Functions		29,920.00
Contingency		580.00
	Grand Total	$30,500.00

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 FISH AND GAME

By Ben Glading
Chief, Game Management Branch

Approved: Date May 18, 1953

Samuel J. Hutchinson
Acting Regional Director

Approved: Date May 26, 1953

SECRETARY OF THE INTERIOR

By O. H. Johnson
Acting Director, Fish & Wildlife Service

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W4-6R-1
Game Range Restoration

CF&RES
R. L. Hubbard
May 25, 1953

MONTHLY PROGRESS REPORT

May 1 to 31, 1953

Accomplishments:

1. Examined the plantings made in cans on the Doyle, Flukey Spring, and Casuse Mt. areas (see Table 1).

A. Doyle

Bitterbrush seedlings are showing from both the plantings made last fall with untreated seed and the one made this spring with stratified seed.

Of the fall planting, many of the seedlings recorded in March have died. The mortality in the uncultivated area is much higher than in the cultivated.

Much lower emergence from the stratified bitterbrush seed planted this spring was recorded in the uncultivated area than in the clean cultivated area.

Artemisia tridentata and Ceanothus cuneatus seed was planted in this area last fall and Artemisia tridentata again this spring. Of these plantings, only two seedlings of Ceanothus cuneatus have emerged. No sagebrush seedlings have been found.

The wide difference in the number of seedlings found in the cans covered against rodents compared to those left open, as well as definite signs of rodent disturbance, indicates considerable rodent use of the seeds.

None of the seed planted on top of the ground has germinated (see Table 1).

B. Casuse Mt.

There was a lower percentage emergence on this area than on the Doyle area. Most of the emergence occurred from seed planted at the one-half inch level.

It looks as though considerable rodent damage occurred on this area also.

c.40 R&H, BOP

C. Flukey Spring

Bitterbrush is the only one of the species planted here (see "Study Progress Report: Species, Site Factors, Planting Method," by A. L. Hormay, March 13, 1953) which has shown any emergence.

No fall plantings were made in the uncultivated area last fall. The response on the cultivated area is about the same as at Doyle (see Table 1).

Plantings were made both on the cultivated and uncultivated sites with stratified seed this spring. Excellent emergence occurred. There is considerable evidence that there was more rodent damage on the uncultivated plot than on the cultivated.

2. Examined the plots at Flukey Spring and Casuse Mt. which were drilled or broadcast to bitterbrush and bitterbrush-crested wheat combination, with A. L. Hormay, M. W. Talbot, and B. O. Pearson.

Some bitterbrush has emerged on the drilled plots but almost none on the broadcast plots, especially the one disked before broadcasting.

Several factors which may have had an effect upon the emergence of the seedlings are:

A. Poor packing of the seedbed prior to planting. The soil, at the time of seedbed preparation last fall, was very dry and this type of soil is almost impossible to pack unless moist.

B. Seed planted too deep. This was a function of the loose seedbed and also to the lack of suitable equipment. A drill provided with depth bands may solve part of this problem.

C. Frost heaving, which perhaps further loosened the soil and provided a condition favorable to rapid drying of the soil at the seed level.

D. A prolonged dry spell in February and March. As most of the seed apparently germinated during this period the lack of moisture undoubtedly had a decided influence on the mortality of the germinating seedlings.

The situation at Casuse was similar to that at Flukey.

3. Met with Roy Bangard (State Division of Forestry), A. L. Hormay and M. W. Talbot (CF&RES), Joe Flynn (Lassen National Forest), and Jim Blaisdell (State Department of Fish and Game) in Susanville to make arrangements for preparation of fire lines and burning an area at Doyle.

4. Met with the following at Doyle on May 15, where a training school was conducted to explain methods of reading and maintaining of the various site factor measuring instruments (see M&S No. 11) to be installed on the Doyle, Wells Meadow, and Flukey Spring experimental areas.

Arthur Hensley	State Dept. of Fish and Game
Treve Wright	do
Russ Bushey	do
Jim Blaisdell	do
Gene Gerdes	do
A. L. Hormay	CF&RES

5. Helped Ben Pearson lay out spray and burning plots at Casuse and Mears.

6. Helped Pearson plant bitterbrush seed spots at Flukey Spring.

Table 1.—Report of bitterbrush can plantings by area, time, seedbed treatment and protection. (5 seeds planted at each depth)

Fall Plantings. Flukey Plot 8-A (Cultivated) inside exclosure

May 7, 1953

No. of cans	Open Depth of planting 0"	½"	1"	1½"	2"	No. of cans	Rodent proof Depth of planting 0"	½"	1"	1½"	2"
1						1					
2						2					
3						3					
4						4			1	1	2
5						5		2	3		
6			1	1		6		1	2		3
7			1			7				1	2
8						8					
9						9		2			
10						10		1	1	2	2
	seeds →		2		1			6	7	4	9
Total spots →			2		1			4	4	3	4

Flukey Plot 10 (Cultivated)

May 12, 1953

Not representative site or planting

1						1			1		
2						2					
3						3					
4						4					
5						5					
6						6			2		
7						7			2	2	
8	1					8			1	1	
9			1			9			2	2	
10	4	3				10			2		
	5	3		1					10	5	
	2	1		1						3	

Casuse Plot 1 & 2 A (Cultivated) — two plots

May 7 1953

1						1					
2			1			2	not rodent proof				
3						3	"	"	"		
4						4	"	"	"		
5						5		3			1
6						6		2			
7						7					
8					2	8		1			
9						9		2	1	2	1
10						10		1			
			1		2		35	9	1	2	2
			1		1		%	26	3	6	6
								5	1	1	2

Summarize on basis remaining cans

Doyle Plot 2-A (Cultivated)

No. of cans	Open Depth of planting 0"	½"	1"	1½"	2"	No. of cans	Rodent proof Depth of planting 0"	½"	1"	1½"	2"
			May 6, 1953								
1						1			1	3	3
2						2		2	1	1	
3						3		2	3	3	4
4						4					
5						5		1	1	1	3
6						6		3	1	4	2
7						7				2	3
8						8				1	
9						9				1	
10						10				2	3
								8	7	18	18

Doyle Plot 1-A (Not Cultivated)*

			May 6, 1953					4	5	9	6
1						1		1	2	1	2
2						2				1	2
3						3	not rodent proof				
4			1			4					2
5						5					
6						6		1	3		2
7						7			3	2	3
8						8				1	2
9						9					
10			1			10		2	8	5	13
								3	3	4	4

* 32 seedlings died between 4/2 and 5/6/53

Wells Meadow Plot 1-A (Cultivated)

March 17 1953

1			1			1					
2						2					
3			1			3					2
4						4					2
5			2			5					
6						6					1
7						7					2
8						8					1
9						9					1
10						10				1	3
			4	3						1,	12
											7

Wells Meadow Plot 2-A (Not Cultivated)

March 17, 1953

1			1			1					3
2						2				4	
3			2			3					1
4						4				1	2
5						5				1	3
6			1			6					
7			3			7				2	1
8						8				1	5
9						9				2	3
10						10					
			7							11	18
			4							6	7

Spring Plantings, Flukey Spring Plot 8-D (Cultivated)

May 7/53

No. of cans	Open: Depth of planting 0"	½"	1"	1½"	2"	Rodent proof: Depth of planting 0"	½"	1"	1½"	2"
1										
2			1		1		1	1	1	3
3								2	4	5
4		2	3					2		
5			3	5	1		1	2	5	5
6		4	2	2	1		3	2	5	3
7				1	2			2	1	3
8			3	4	4		2	2	2	
9		1	5	5	1			2	3	4
10		2	1	1	1		1	4	3	4
		9	18	18	11		8	19	24	27

Flukey Spring Plot 11-D (Not Cultivated)

	4	7	6	7			5	9	9	7
1						1				
2			4	4	May 7/53	2	3	4	4	2
3						3		1		1
4						4	3	3	2	4
5						5		3	3	1
6						6	3	4	4	2
7			2	2		7				
8				3		8	3	5	4	4
9			1			9		1	1	4
10				3		10		4	1	4
	3		7	41			12	25	19	22

Doyle Plot 1-A 2 (Cultivated)

	1		8	4			4	8	7	8
1				3	May 15/53	1		4	3	4
2				1		2	1	3	2	
3						3		2	3	3
4						4	2		2	
5						5	1	2	3	4
6						6		3	2	3
7			1			7		2	3	2
8			2			8	3	3	2	3
9						9	3	2	2	
10		1	5			10			2	
	1		8	4			10	21	24	19

Doyle Plot 1-B 2 (Not Cultivated

	1	3	2				5	8	10	6
1					May 15/53	1				
2						2				
3				2		3				
4						4				
5						5				
6				1		6		2		
7						7				
8						8				
9						9	4	2	2	
10						10				
				3			4	4	2	
				2	-6-		1	2	1	

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W46R-1
Game Range Restoration

CF&RES
B. O. Pearson
May 25, 1953

MONTHLY PROGRESS REPORT

May 1 to 31, 1953

Accomplishments:

1. Laid out burn and spray plots at the Casuse Mt. area. The areas to be burned are 1 acre in size. Five of these acre plots have been laid out and staked for eight 132' transects and 104 20" x 20" quadrats for each plot.

Twelve 20' x 218' plots have been laid out to test spray treatments. Each of these plots will be sampled with two 132' transects and 26 20" x 20" quadrats.

George Fischer has estimated that the earliest date for burning without prior treatment will be July 1.

2. Laid out burn and spray plots in the Mears burn. Five 1-acre plots have been laid out and eight of the smaller spray plots. George Fischer is planning to put a crew into this area to cut down the standing trees and carry off the heavy fuel likely to create dangerous burning conditions.

3. Laid out four 1-acre plots at the Flukey Spring area for spraying and burning.

4. George Fischer is making arrangements to have the necessary fire lines constructed around the plots to be burned.

5. Almost constant rain and snow during the past several weeks has slowed up the fencing of the Flukey Spring area and other phases of the work considerably.

6. Planted bitterbrush seed spots at Flukey Spring.

7. Prepared sensitized paper for checking spray patterns.

c. to RLH ✓
BOP
RLH

COPY

A5fs-15180 NUMBER 1K-W46R2-2A

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 8th day of June, 1953, 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 the "Station":

W I T N E S S E T H

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 needs 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 purchases, 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, 1953 and January, April and July, 1954, 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 12425 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 Nine Thousand Dollars ($29,000.00) 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 $29,000.00 and this agreement shall commence July 1, 1953 and shall remain in effect until June 30, 1954, 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 shallbe 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 generalbenefit.

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 W. T. Shannon
Deputy Director

UNITED STATES DEPARTMENT OF AGRICULTURE
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

By Stephen N. Wyckoff
Director

Department of Finance
Approved June 24, 1953
James S. Dean, Director
By Louis J. Heinzer

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W46R-1
Game Range Restoration

CF&RES
R. L. Hubbard
June 19, 1953

MONTHLY PROGRESS REPORT

June 1 to 30, 1953

Accomplishments:

1. Helped B. O. Pearson sample the vegetation on spray and burn plots prior to treatment.

2. Helped B. O.Pearson spray the various plots (see Study Progress Report: Site preparation, June 20, 1953, by B. O. Pearson).

3. Partially marked plots and sub-plots at Flukey, according to M & S #9.

4. Made phenology observations at Flukey.

5. Maintained soil moisture readings.

6. Staked bitterbrush seedlings on plots seeded last fall

7. Planted seedlings of various browse species furnished by Clarence Quick of the Bureau of Entomology and Plant Quarantine. These species were:

Ceanothus cuneatus
Lotus crassifolius
Garrya fremontia

There were 8 older G. fremontia seedlings which have survived. The small seedlings have all died. Most of these retained in the pots but exposed to outside conditions have also died.

8. See B. O. Pearson's report for additional details.

c. to RLH ✓
BOP
RLH
file

STATE California

PROJECT NO. W-6R-1

DATE July 1, 1953

QUARTERLY PROGRESS REPORT

SURVEYS AND INVESTIGATIONS

as required by

FEDERAL AID IN WILDLIFE RESTORATION ACT

1. Title of Project: Game Range Restoration

2. Supervisors: Ben Glading, Chief, and William P. Dasmann, Senior Game Biologist, Game Management Branch, California Department of Fish and Game

3. Leaders: M. W. Talbot and A. L. Hormay

   Assistants: B. O. Pearson and R. L. Hubbard

4. Cooperating Agency: California Forest and Range Experiment Station

5. Summary report of progress during the fourth quarter, April 1 to June 30, 1953. (This report is not for publication.)

Purpose

The primary objective of this report is to develop cultural methods of re-establishing and extending browse species suitable for food or cover on deteriorated game ranges in California. Both native and introduced species are being considered. The work is being started in the Eastside Region of the State on deer winter ranges which cover a distance of about 500 miles from Oregon to the southern end of the Sierra Nevada mountains. These ranges are heavily deteriorated. They lie in a comparatively light snow belt, but in heavy precipitation years snow covers up low growing forage and hinders the movement of the deer. Under these conditions shrubs become premium forage plants for deer because of their upstanding growth habit. Bitterbrush (Purshia tridentata) is the most important game browse in the region and is being given special attention in these studies.

General Accomplishments

Most of the past quarter was devoted to: (1) Measuring germination and initial survival of browse species planted from seed last fall and this spring. (2) Laying out, measuring and treating 26 chemical spray plots, 4 burning plots, and 2 cultivated plots aimed at developing acceptable methods of site preparation. Results of the site preparation work will be reported after the first reactions to the treatments are recorded. The present report deals with some of the results of the shrub seedings.

Background and Scope of Seeding Tests

The seeding tests reported here are limited to some made by hand in planting cans on the Flukey Spring, Doyle and Wells Meadow experimental areas last fall and this spring, under protection from grazing by livestock and big-game animals. This report covers the responses obtained from planting time last fall, late in November, to the end of June this year. Approximately the first 100 days of seedling growth are encompassed in this period.

A general description of the experimental areas and of the design of the plantings is given in the January quarterly progress report. Attached are maps showing the location of the experimental areas in the deer winter range area being studied.

Of 13 species of shrubs planted last fall -- all with untreated seed -- only bitterbrush (Purshia tridentata) and buckbrush (Ceanothus cuneatus) germinated this spring. Of 3 species planted this spring -- bitterbrush (with stratified seed) and buckbrush and big sagebrush (Artemisia tridentata) with untreated seed -- only bitterbrush germinated. Germination of buckbrush in the fall plantings was negligible. Only bitterbrush germinated appreciably in both fall and spring plantings. The following report deals with this species.

Brief Review of Planting Method

Five seeds of bitterbrush were planted at each of five depths -- 0, 0.5, 1.0, 1.5 and 2.0 inches -- in each planting can. Ten randomized replications of cans were set up for basic comparisons between treatments or conditions. Comparisons were made between:

1. Planting depths
2. Sites (differing in vegetation, soils and weather)
3. Cultivated and uncultivated areas (differing in plant competition)
4. Plantings exposed and protected from rodents and birds

Bitterbrush Results

Fall Planting

Under the most favorable conditions provided in these tests, 50 percent germination of seeds and 90 percent germination of seed spots were obtained. Little or no germination was obtained under some of the conditions set up.

The principal factors believed to be responsible for the low level of germination obtained under the most favorable conditions employed and to affect all plantings generally were (1) a loose seedbed created when the planting cans were set in the soil, and (2) unfavorable weather during germination. The controlled comparisons were superimposed on these general conditions.

Depth of planting.--Highest germination, emergence and initial seedling survival were obtained from plantings made at the 1.5 and 2.0 inch depths. No germination was obtained from seeds placed on the soil surface (Table 1). The gradation in percentage emergence and initial survival from the shallower to the deeper plantings reflects differences in soil moisture at these levels. Drying of the top soil during germination appears to be the main cause of low germination at the 0.5 and 1.0 inch levels.

Noticeably lower germination was obtained from the shallow plantings at Wells Meadow -- the driest of the three experimental sites -- than at the two northerly sites. The germination recorded for the 1.0 and 1.5 inch spots on this site is probably abnormally low. Sand was blown onto these two positions in most of the cans by winds. In some cans the sand deposit definitely prevented seedling emergence.

The unfavorable soil moisture conditions that prevailed at Wells Meadow during germination this spring are reflected in Table 2. No precipitation fell during a 48-day period prior to germination nor for a period of 7 days thereafter. Even on the other two sites moisture in the upper inch of soil during the critical days of germination was low for best growth.

The average mortality of seedlings on all three sites during the first 75 days of growth, based on the number of seedlings that emerged, was 45 percent. This mortality is attributed mainly to drying of the top soil. Mortality was somewhat higher in the shallower plantings than in the deeper plantings. Insects killed a few of these seedlings.

The large loss of seedlings on the Flukey Spring area is believed to be due to heaving of the planting cans in early spring, resulting in a looser, more easily dried soil. No noticeable heaving of cans was observed on the Doyle and Wells Meadow sites, where the soils are more sandy.

These early results point to the need for deep planting, to get away as much as possible from the harmful effects of drying top soil during the germination period. Observations indicate that 2 inches is about the maximum depth from which bitterbrush seedlings can emerge. However, further tests will be made to check this point. Furthermore, highest survival and establishment may not be correlated most closely with maximum emergence depth but with some shallower depth. Before much can be concluded on depth of planting, a few crops of seedlings will have to be followed through the establishment period and over a few years to cover the effects of variations in weather.

Plant competition.--Early survival of seedlings was considerably greater on areas freed of plant competition by cultivation than on areas where the existing native plant cover was left intact. Seedling emergence on cultivated and uncultivated areas was reasonably comparable but the mortality rate the first 85 days after emergence was much greater on the uncultivated areas (Table 3). The need for reducing as much of the existing plant cover on planting site to insure maximum establishment of seeded species is clearly indicated.

Table 1.--Effect of planting depth on the emergence and initial growth of bitterbrush seedlings on three sites

Plantings on cultivated areas protected from grazing, rodents and birds

Site	Depth of planting (in.)				
	0	0.5	1.0	1.5	2.0
	Emergence percent 1/ (28 days after germination)				
Flukey Spring	0	12	14	8	18
Doyle	0	16	18	46	38
Wells Meadow	0	0	6	6	40
Average	0	9	13	20	32
	Survival percent 1/ (103 days after germination)				
Flukey Spring	0	2	2	0	0
Doyle	0	14	8	34	34
Wells Meadow	0	0	4	4	30
Average	0	5	5	13	21
	Mortality percent (during the first 75 days after emergence)				
	-	44	62	35	34

45 Aver.

1/ Based on 50 seeds planted at each depth.

Table 2.--Soil moisture and precipitation during germination of bitterbrush on three sites

Site	Soil moisture rating at 0.75 inch below soil surface at time of seed germination	Precipitation at specified periods before and after seed germination							
		Days before				Days after			
		40	30	20	10	10	20	30	40
		..... inches							
Flukey Spring	Damp [1]	0	.50	.20	.73	.21	0	0	.65
Doyle	Damp	0	.25	0	.67	0	.06	.16	.90
Wells Meadow	Dry [2]	0	0	T	0	.27	T	0	.02

1/ Damp = growth possible
2/ Dry = growth not possible

Table 3.--Effect of plant competition on the initial survival of bitterbrush planted at various depths

Plantings protected from grazing, rodents and birds

Experimental area	Cultivated site 1/				Uncultivated site 2/			
	Planting depth (in.)				Planting depth (in.)			
	0.5	1.0	1.5	2.0	0.5	1.0	1.5	2.0
	No. of seedlings 3/				No. of seedlings			
DOYLE								
20 days after germination	8	9	23	19	7	10	22	23
105 " " "	7	4	17	17	1	1	2	6
Percent loss	12	56	26	11	86	90	91	74
WELLS MEADOW								
20 days after germination	-	3	3	20	-	1	16	25
105 " " "	-	2	2	15	-	0	4	4
Percent loss	-	33	33	20	-	100	75	84

1/ Freed of competition by plowing
2/ Undisturbed natural vegetation cover
3/ Based on 50 seeds planted at each depth class

The effect of plant competition on seedling growth was reflected in the height and vigor of the seedlings as well as in the mortality rate. On the cultivated sites the live dominant seedlings in the seed spots averaged 2.3 inches in height. On the uncultivated sites they averaged only 1.1 inches and were much less vigorous.

Rodents.--Rodents took many seeds prior to germination and also destroyed a few seedlings during germination and emergence in the exposed cans. During emergence the rodents seemed to prospect the seed spots for unsprouted or lightly sprouted seeds. In the process they would often mine out growing seedlings or expose their roots, causing the plants to die. The average loss of seeds and seedlings to rodents on the five sites shown in Table 4 was 87 percent. The losses were about the same on cultivated and uncultivated areas and on the various experimental sites.

The rodents causing the seedling losses have not been determined yet, but evidence points to mice and kangaroo rats. The rodents responsible will be identified in future work.

These results indicate that a high percentage of the seed planted in a practical reseeding program may be lost to rodents. Rodent control is therefore indicated. The effectiveness of tetramine in repelling or controlling rodents will be tested under California conditions. This chemical is giving encouraging experimental results in other regions.

Spring Planting

These plantings were made with stratified seeds on cultivated sites on the Flukey Spring and Doyle areas about 8 days after fall planted seeds started to germinate in the spring. The spring sown seed was partly sprouted so both spring and fall plantings got away to about the same start. Both emergence and initial seedling survival were slightly better in the spring plantings (Table 5) due mainly, it is believed, to a better seedbed condition and to more favorable soil moisture at planting time. The period of heavy freezing and soil heaving that affected the fall planting preceded the spring plantings.

In the spring plantings there was a gain in seedlings during the 71 days between the first and second examinations. In the fall planting, 46 percent of the seedlings present in the first examination died during this period.

A comparison of initial seedling losses from plant competition between spring and fall plantings was obtainable only on the Doyle area. Here seedling losses amounted to 92 percent in spring plantings and 64 percent in fall plantings by the second examination. Surviving seedlings from both spring and fall plantings had about the same height and vigor.

Rodents reduced seedling emergence by 55 percent in spring plantings and 93 percent in fall planting, compared with check plots.

Table 4.--Effect of rodents on the emergence of bitterbrush seedlings

Experimental site	Depth of planting (in.) 0	0.5	1.0	1.5	2.0	Total
	Plantings protected from grazing					
	No. of surviving seedlings approx. 28 days after germination					
	Cultivated site					
FLUKEY SPRING						
Protected from rodents	0	6	7	4	9	26
Exposed to rodents	0	0	0	2	1	3
DOYLE						
Protected from rodents	0	8	9	23	19	59
Exposed to rodents	0	0	3	0	0	3
WELLS MEADOW						
Protected from rodents	0	0	3	3	20	26
Exposed to rodents	0	0	0	0	9	9
	Uncultivated site					
DOYLE						
Protected from rodents	0	7	10	22	23	62
Exposed to rodents	0	1	2	1	2	6
WELLS MEADOW						
Protected from rodents	0	0	1	16	25	42
Exposed to rodents	0	0	0	0	7	7
TOTAL SURVIVING SEEDLINGS						
Protected from rodents						215
Exposed to rodents						28
MORTALITY DUE TO RODENTS, PERCENT						87

Table 5.--Emergence and initial survival of bitterbrush from spring and fall seedings

Plantings on cultivated areas protected from grazing and rodents

	Spring Planting					Fall Planting				
Planting date	March 31, 1953					November 15, 1952				
First sprouting	March 31, 1953					March 23, 1953				
First emergence	April 8, 1953					March 27, 1953				
	Planting depth (in.)					Planting depth (in.)				
Site	0	0.5	1.0	1.5	2.0	0	0.5	1.0	1.5	2.0
	Emergence and survival percent					Emergence and survival percent				
FLUKEY SPRING										
1st examination (5/7)	0	16	38	48	54	0	12	14	8	18
2nd examination (6/24)	0	32	40	48	50	0	2	2	0	0
DOYLE										
1st examination (5/15)	0	20	42	48	38	0	16	18	46	38
2nd examination (6/28)	0	30	42	52	24	0	14	8	34	34

Generally speaking the spring plantings behaved much like the fall plantings and further tests are needed to bring out the superiority of one time of planting over the other. However, the possibility of spring planting is evident. This is rather important in a dry area like the Eastside Region of California. Here fall planting is always a gamble. Not enough precipitation may fall in a given year to permit seedlings to survive the long, dry summer. Or soil moisture at seed level during the spring germination period may prove unfavorable for growth. With spring planting there is an opportunity to appraise both of these situations before planting, and then withhold or ~~carried~~ carry out seedings depending on the conditions that are found.

Summary Comments

Reseeding tests with bitterbrush carried through the first 100 days of growth of the first experimental season point to the need for deep planting -- 1.5 to 2.0 inches -- to minimize the mortality in germinating seedlings in the spring brought about by drying top soil. Maximum seedling emergence depth is about 2.0 inches.

Reduction of the existing plant cover (competition) on planting sites is essential for highest seedling survival. Rodent control appears necessary to prevent heavy losses of planted seeds before and during germination.

Both spring and fall planting are possible. Spring planting holds the greater promise for consistent success in dry regions where soil moisture and growing conditions are erratic and unpredictable.

SUBMITTED BY

A. L. Hormay

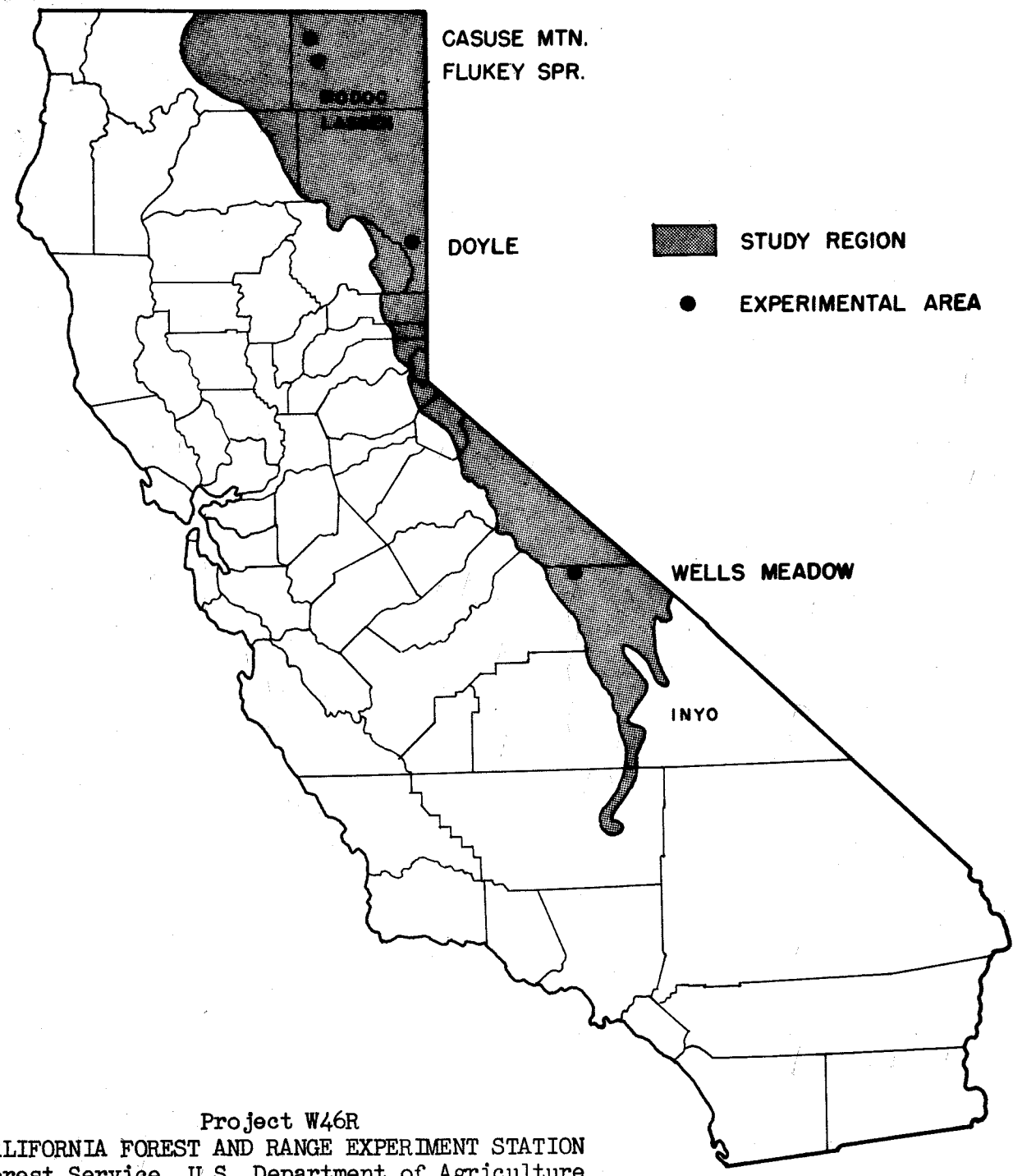
Project Leader

APPROVED BY:
CALIFORNIA DEPARTMENT OF FISH AND GAME

By _____
Chief, Game Management Branch

DATE _____

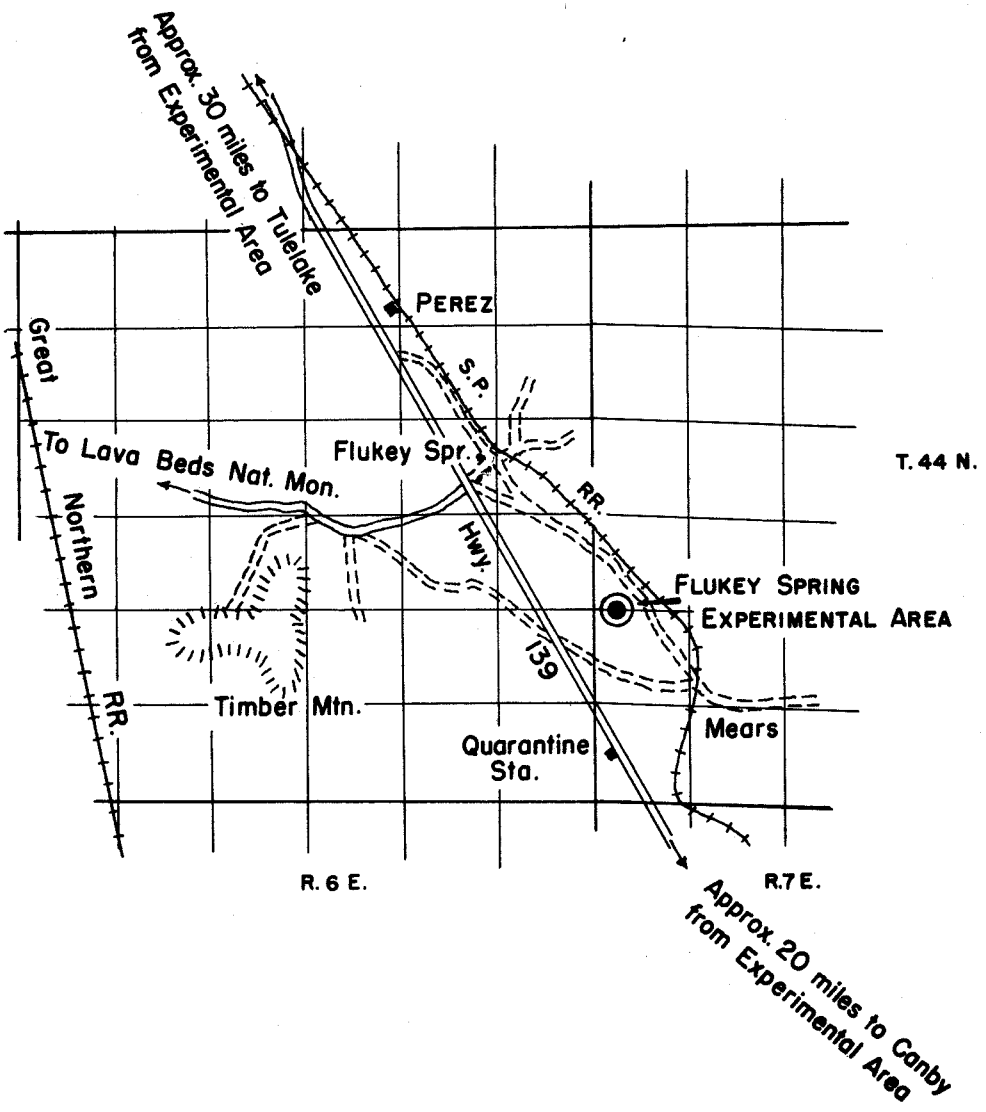
EXPERIMENTAL AREAS
GAME RANGE RESTORATION
CALIFORNIA



Project W46R
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
Forest Service, U.S. Department of Agriculture
in cooperation with
CALIFORNIA DEPARTMENT OF FISH AND GAME

Date: June 1953

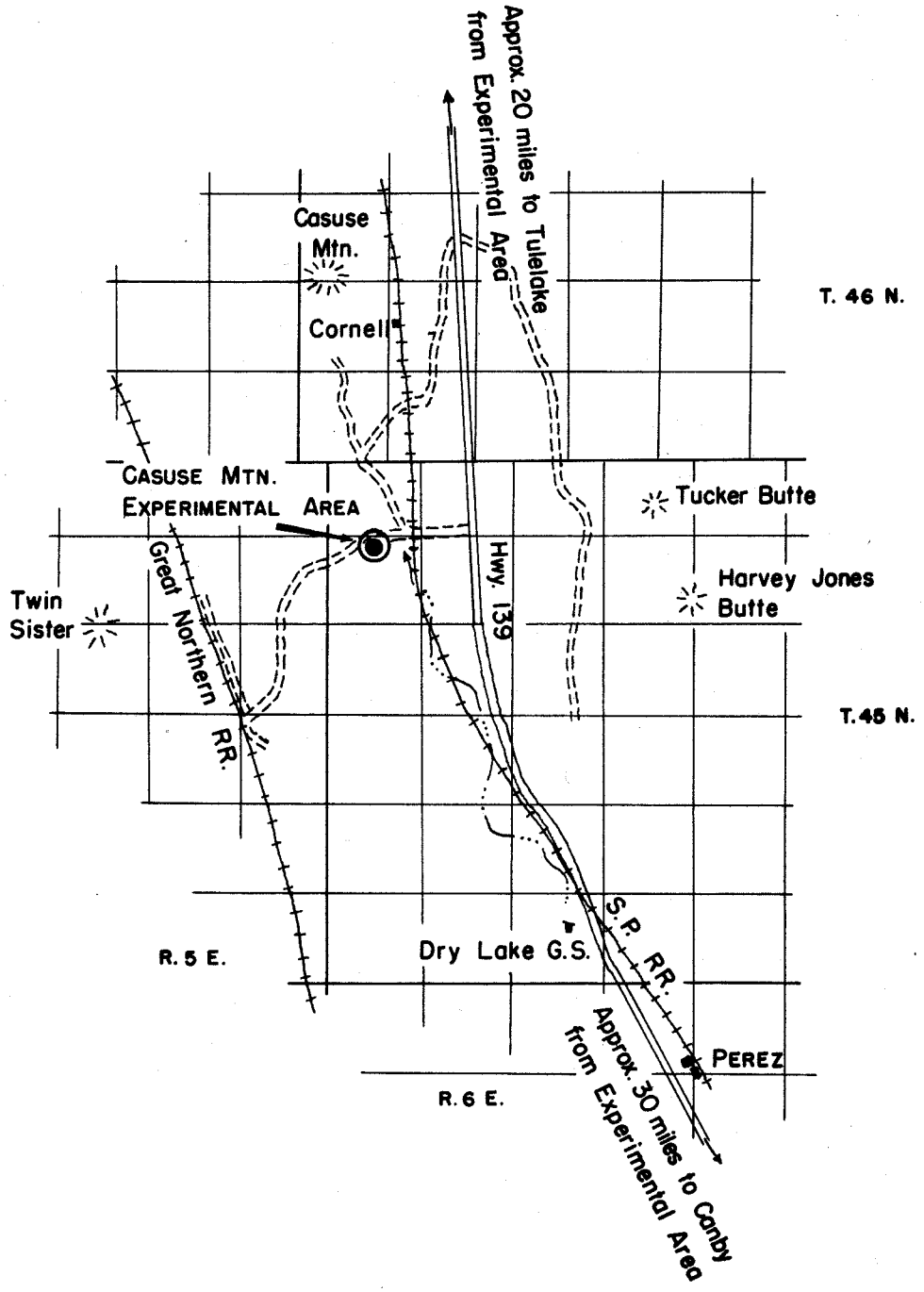
FLUKEY SPRING EXPERIMENTAL AREA
GAME RANGE RESTORATION
MODOC COUNTY, CALIFORNIA



Project W46R
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
Forest Service, U.S. Department of Agriculture
in cooperation with
CALIFORNIA DEPARTMENT OF FISH AND GAME

Date: June 1953

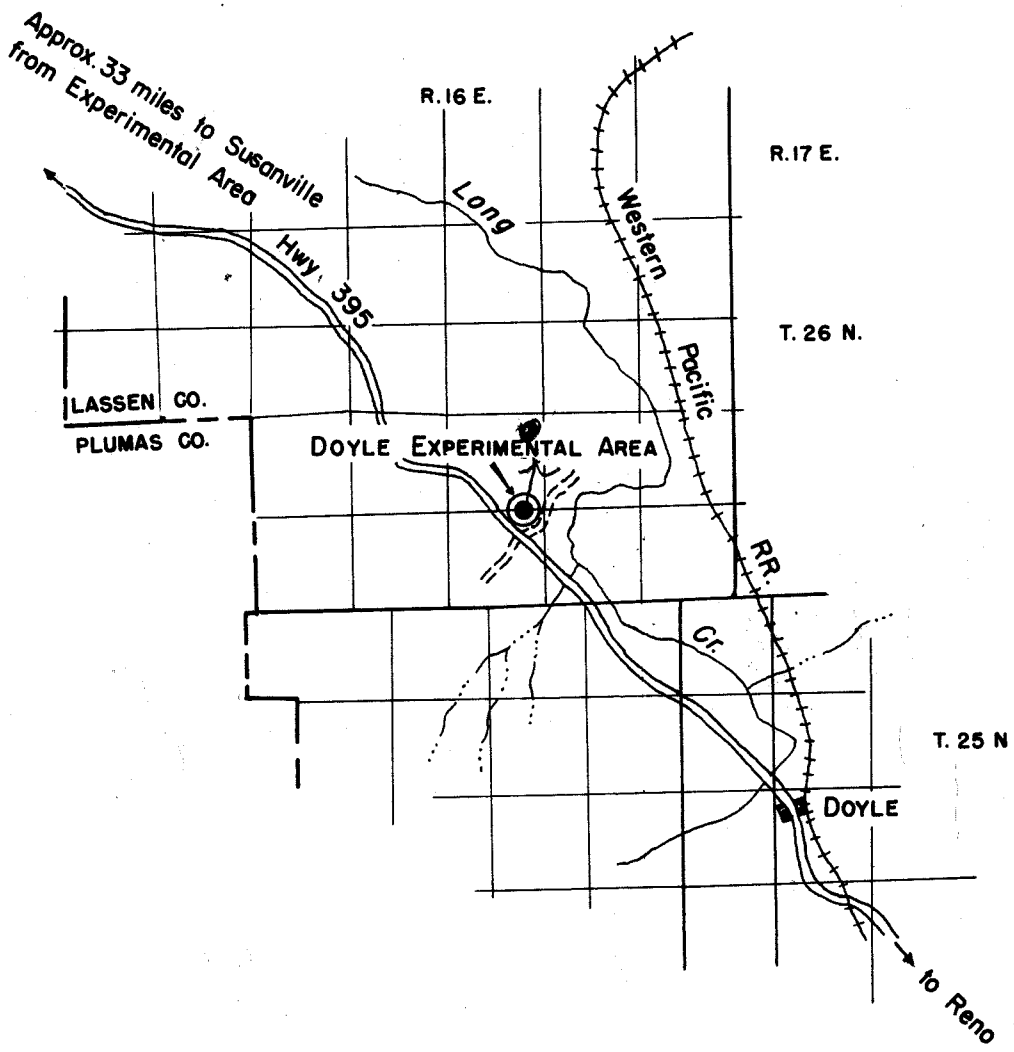
CASUSE MTN. EXPERIMENTAL AREA
GAME RANGE RESTORATION
MODOC COUNTY, CALIFORNIA



Project W46R
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
Forest Service, U.S. Department of Agriculture
in cooperation with
CALIFORNIA DEPARTMENT OF FISH AND GAME

Date: June 1953

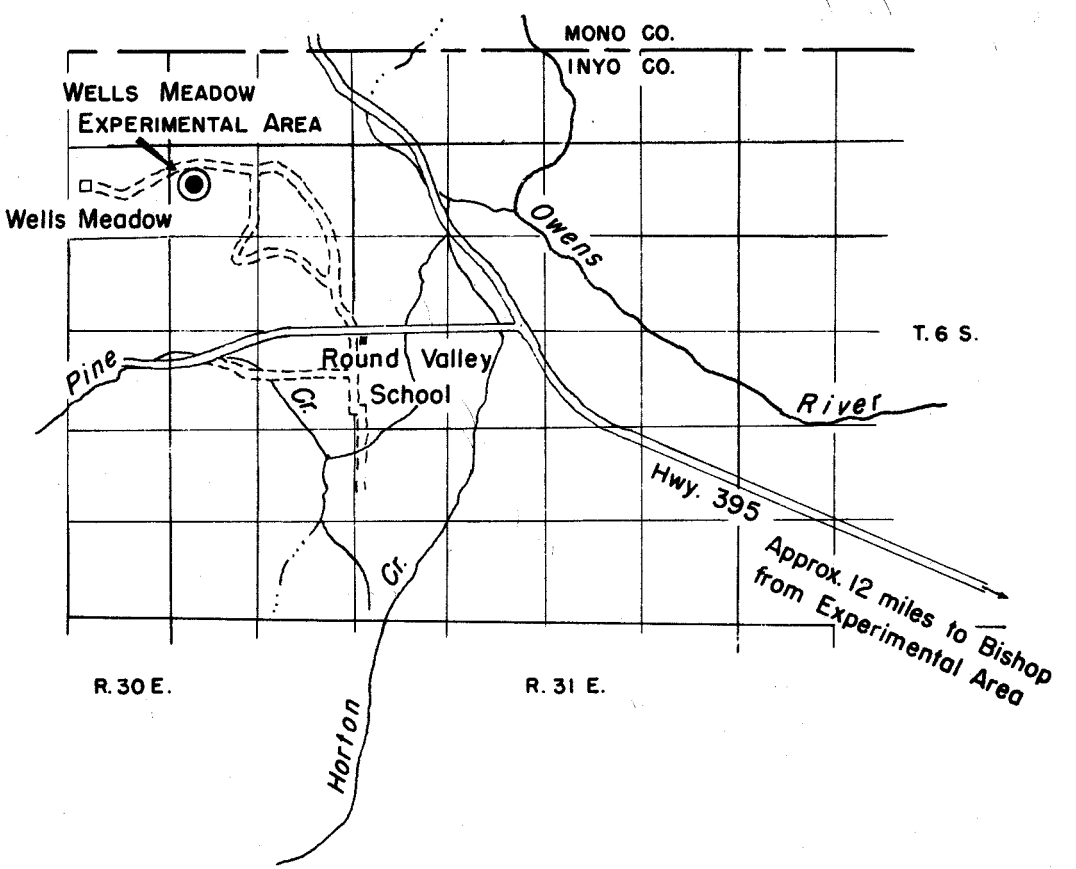
DOYLE EXPERIMENTAL AREA
GAME RANGE RESTORATION
LASSEN COUNTY, CALIFORNIA



Project W46R
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
Forest Service, U.S. Department of Agriculture
in cooperation with
CALIFORNIA DEPARTMENT OF FISH AND GAME

Date: June 1953

WELLS MEADOW EXPERIMENTAL AREA
GAME RANGE RESTORATION
INYO COUNTY, CALIFORNIA



Project W46R
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
Forest Service, U.S. Department of Agriculture
in cooperation with
CALIFORNIA DEPARTMENT OF FISH AND GAME

Date: June 1953

PR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W-65R-2
Game Range Restoration

CYRENE
July 1, 1953

JOB PLAN

July 1 to 31, 1953

Objectives:

1. **Site preparation**

Complete plot spraying and burning work planned for this spring.

2. **Site factors**

Start installation of weather instrument shelters and instruments on the Finkey Spring, Doyle, and Wells Meadow areas. Maintain phenology and soil moisture records.

3. **Species germination and establishment**

Make browse seedling counts on plantings made to date to determine survival and mortality related to causes where possible.

c. to Fish & Game
R.H. ✓
BOP
R.H.
file

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W46R-2
Game Range Restoration

CF&RES
R. L. Hubbard
July 26, 1953

MONTHLY PROGRESS REPORT

July, 1953

June 20 (Saturday) - Pearson and I worked on monthly report.

June 21 (Sunday)

June 22 (Monday) - Sampled annual vegetation on Flukey Plot #16.

June 23 (Tuesday) - Sampled perennial vegetation on Flukey Plot #16.

June 24 (Wednesday) - A.M. Finished sampling perennial vegetation on 16-C. Moved tractor from Dry Lake to Plot 16. P.M. Sprayed plots 16-A and B at Flukey Spring.

June 25 (Thursday) - Sprayed Flukey plot 14-A and B. Went into Tulelake to have spray rig repaired.

June 26 (Friday) - Sampled annual and perennial vegetation on Flukey plots 14-C, 14-D and 14-E.

June 27 (Saturday) - Left for Blacks Mountain with Cornelius to pick up International pickup 93E.

June 28 (Sunday) - Returned to Quarantine Station. Hormay arrived in afternoon and worked on Quarterly Report.

June 29 (Monday) - A.M. Examined can plantings at Flukey and Casuse. Height of seedlings was recorded as well as number of seedlings. P.M. Worked on Quarterly Report with Pearson and Hormay. Discussed plans for future.

June 30 (Tuesday) - A.M. Went to Tulelake to pick up a load of iron pegs. P.M. Prepared for burning at Casuse.

July 1 (Wednesday) - A.M. Laid out sampling transects on 14-D at Flukey. P.M. Laid out spray plots at the horse pasture north of Dry Lake G. S. Moved spray equipment into position.

July 2 (Thursday) - Set quads for 14-E. Made forms for seedling samples. Removed rock for fence line at Flukey. Sampled seedling survival in plot 1 at Flukey.

c. to RLH ✓
BSP
RLH
S/P

2 - July progress report by RLH

July 3 (Friday) - Sprayed horse pasture with combinations of 2,4-D and 2,4,5-T. Sampled 14-D and E.

July 4 (Saturday) -

July 5 (Sunday)

July 6 (Monday) - Spent day at Quarantine Station checking over data sheets.

July 7 (Tuesday) - A.M. Finished vegetation samples for Flukey plots 14-D and E. P.M. Took S.M.U. readings. Recorded seedling survival on Flukey plot 1. Burned Casuse plot 4-A. Only about 50% of the ground area was burned. The probable causes of this were: insufficient fuel and too high fuel moisture.

July 8 (Wednesday) - Checked Dry Lake crew out on spray equipment. Finished sampling seedling survival on Flukey plot 1 and 2.

July 9 (Thursday) - Sampled burn at Casuse for percent ground area and percent top cover burned. Observed spray plots. Weeded plot 1 at Flukey. In doing this we broke the plot up into 8 subplots; every other one of which was weeded.

July 10 (Friday) - Tagged 50 CHYn bushes on each of four spray plots at the horse pasture. Went into Tulelake to pick up a load of iron pegs.

July 11 (Saturday)

July 12 (Sunday)

July 13 (Monday) - A.M. Sampled plot 1 at Flukey for survival and cotyledon height. P.M. Trip to Tulelake for load of pegs.

July 14 (Tuesday) - Prepared for trip to Doyle.

July 15 (Wednesday) - Trip to Doyle. Checked in with Ernie Draves and Ben Beard.

July 16 (Thursday) - Checked bitterbrush seed; arranged for collection area with Mr. Bennett and Mr. Blickenstaff, local ranchers. No Forest labor available. Set weather shelter at Doyle.

July 17 (Friday) - Spent most of the day in Susanville checking with Supervisor's office, Ernie Draves, Stewart, Lord, Zimmerman (sportsman), and State employment office in an effort to locate help for seed collection. Lined up a number of men through the employment office to collect seed on a $1.00 per lb. basis. Checked with Hormay in Berkeley on the legitimacy of this. Gathered necessary collecting equipment.

3 - July progress report by RLH

July 18 (Saturday) - Started seed collection 7 men.

July 19 (Sunday) - Continued seed collection - 5 men.

July 20 (Monday) - Continued seed collection - 6 men.

July 21 (Tuesday) - Continued seed collection - 5 men. Painted weather shelter at Doyle experimental area.

July 22 (Wednesday) - Continued seed collection - 5 men.

July 23 (Thursday) - Almost all of the seed was cast; stopped collection with a total of 502.8 lbs. of fruit. Left Doyle for Blacks Mountain. Picked up weather shelter.

July 24 (Friday) - Left Blacks Mountain. Went to junction of 299 and 89 to check on Ceanothus cuneatus. Ccn has a very poor seed crop in this area. There is a large patch of CCu on top of Bieber grade at turnoff to Old Tollhouse and Sugar Pine Flat which has a fair seed crop. This area should be ready for collection about the first of August.

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W46R-2
Game Range Restoration

CF&RES
B. O. Pearson
July 27, 1953

MONTHLY PROGRESS REPORT

July, 1953

June 20 (Saturday) - A.M. Monthly report.

June 21 (Sunday)

June 22 (Monday) - Hubbard and I took annual samples for plot 16-A, B, C D and E.

June 23 (Tuesday) - Hubbard and I took perennial samples for plot 16-A and B.

June 24 (Wednesday) - A.M. Hubbard and I took perennial samples for 16-C and moved tractor to Mears from Dry Lake. P.M. Sprayed plots 16-A and B (acre plots for burning). From 6:30 to 11:00 P.M. attended guard school at Hackamore.

June 25 (Thursday) - A.M. Sprayed plots 14-A and B (acre plots for burning). P.M. Took spray boom in to Tulelake for repair of broken elbow and strengthened tank mounting.

June 26 (Friday) - Hubbard, Bunstein and crew man took annual and perennial sampling on 14-C, D and E. Bunstein pulled by A.R. and replaced by crew man at 1:00 P.M.

June 27 (Saturday) - A.M. Labelled treatment, date, and plot numbers on spray plots at Flukey and Mears (chemical plots 13 through 16). P.M. Labelled treatment, etc. at Casuse plots 3 and 4.

June 28 (Sunday)

June 29 (Monday) - A.M. Hubbard and I worked on can readings at Flukey and Casuse. P.M. Hormay, Hubbard and I on Quarterly Report at Quarantine Station. Plant identification and summer work plans.

June 30 (Tuesday) - A.M. Hubbard and I to Tulelake to pick up load of stakes. P.M. Hubbard, Dry Lake crew, and I at Casuse for trial burning. Equipment not ready for burning Hauch torch full of sediment, etc. fuzees wet. Repair of Hauch torch.

July 1 (Wednesday) - A.M. Put Curlee (Dry Lake crew) on plot 16 driving quad stakes to 1' height. Hubbard and I put in transects on 14-D. P.M. Lay and move equipment to spray plot at Dry Lake horse pasture (between 139 and RR).

c. 40 RLH ✓
BOP
RLH
file

2 - July progress report by BOP

July 2 (Thursday) - A.M. Curlee on assigned job at plot 16. Hubbard and I set quads for 14-E; made forms for seedling samples. P.M. Hubbard and I removed rock in trench for fence at Flukey; seedling survival sampling at Flukey plot 1. Tulelake for spray tip and flame thrower.

July 3 (Friday) - A.M. Sprayed horse pasture at Dry Lake with combination of 2,4-D and 2,4,5-T application made at rate of 2 lbs. acid per acre in 40 gallons solution. Pasture has vigorous young growth of CHYn. Average clump about 2' x 2'. Three plots are about 100' x 400'. The 2,4,5-T plot didn't get uniform or good coverage. P.M. Hubbard and I made plot forms for sampling. Hubbard, myself, and two crew men recorders set stakes and partially sampled 14-D and E. Relieved Curlee from job at 3:30 P.M.

July 4 (Saturday)

July 5 (Sunday)

July 6 (Monday) - Preliminary check on all vegetation type sheets to see that all data is recorded and all sheets accounted for.

July 7 (Tuesday) - A.M. Hubbard, myself, and two crew members finished vegetation samples for 14-D and E. All sampling now complete. P.M. Soil moisture readings and seedling record for plot 1. Burned Casuse plot 4-A. Wind from south 8 m.p.h., stick 4½ temperature 95, humidity 20. Prepare spray rig for West Horse Pasture spraying (approximately 20 acres) per acre formula 1 lb. 2,4-D B E, 1 lb. 2,4,5-T to 1/2 gallon diesel and 9-1/2 gallons water. Formula will permit 4-acre spraying per tank load.

July 8 (Wednesday) - A.M. Training Dry Lake crew to do spray job (8 acres sprayed). Hubbard and I on seedling survival count. P.M. In Tulelake getting boom purchase order straightened out, made post driver, and repaired flame thrower.

July 9 (Thursday) - A.M. Sampled Casuse for burn percent (ground area and vegetation; observation of chemical spray plots. P.M. Hubbard and I laid out and weeded Flukey plot 1 (area brokkn into four duplicate sub-plots).

July 10 (Friday) - Hubbard and I tagged 50 CHYn plants on each of four spray plots at Dry Lake Horse Pasture. Plants located along one strip of each spray area as determined by tire tracks of tractor.

July 11 (Saturday)

July 12 (Sunday)

July 13 (Monday) - Sampled 8 sub-plots (Flukey plot 1) for seedling survival. To Tulelake for stakes. Identified unknown A as two plants (Godetia and Epilobium).

July 14 (Tuesday) - A.M. Hubbard and I attempted to burn at Flukey (plot 14, too green). P.M. Prepared for trip to Doyle.

July 15 (Wednesday) - Flukey to McCloud for shelter and hygrothermograph. Condenser on 72E out at Hat Creek and repaired. Also contacted Bureau of Entomology for look at Flukey plants for following Monday. Arrived at Doyle 10:00 P.M.

July 16 (Thursday) - Hubbard and I did can reading at Doyle and found Forest had no manpower for bitterbrush collection.

July 17 (Friday) - Doyle to Susanville. Dug up manpower and equipment for job of seed collection. Susanville to Flukey.

July 18 (Saturday)

July 19 (Sunday) - Seedling survival of plants plots 2, 5, and 6 at Flukey and 1 at Casuse.

July 20 (Monday) - Seedling survival at Flukey, plot 1 and soil moisture reading. Depart for Doyle; arrive at midnight.

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W46R-2
Game Range Restoration

August 19, 1953

Mr. D. F. Tillotson
Supervising Game Manager
Department of Fish and Game
926 "J" Street
Sacramento, California

Dear Dan:

In the rush of things forgot all about sending you word of what we expected to do in August on the game-browse project. Ten days of Washington Office inspection of our range research program and illness during the past week were partly responsible.

Hubbard and Pearson, however, have been carrying on strongly. Some points we planned to cover were as follows:

1. Make systematic records of soil moisture, weather factors, and plant growth and development.

2. Determine the length of root growth of bitterbrush seedlings at about 2-week intervals.

3. Make periodic examination of bitterbrush seedlings planted under various conditions for survival and mortality. These records will be related to the factors measured in 1. and 2. above and others.

4. Collect seed of browse species as they ripen this month, Ceanothus cuneatus and Peraphyllum ramosissimum particularly.

5. Clean approximately 400 pounds of bitterbrush seed.

Sincerely,

A. L. Hormay

A. L. HORMAY
Range Conservationist

cc: BOP
RLH
ALH ✓

RR-CAL
COOPERATION
State of California
Department of Fish and Game
Project W46R-2

CF&RES
R. L. Hubbard
August 21, 1953

MONTHLY PROGRESS REPORT

July 27 to August 20, 1953

July 27 (Monday) - A.M. Began check on bitterbrush seedling survival at Flukey Spring. P.M. Burned off unsprayed and sprayed plots at Flukey Spring.

July 28 (Tuesday) - Finished checking seedling survival at Flukey Spring and Casuse. Burned off Casuse unsprayed plot.

July 29 (Wednesday) - Spent day at Quarantine Station working on data and waiting for a group of Fish and Game men who failed to show up.

July 30 (Thursday) - Dug up root systems at Flukey Spring. Put up weather shelter at Flukey Spring.

July 31 (Friday) - Continued digging up root systems. Went to Bieber to check on Ceanothus cuneatus seed.

August 3 (Monday) - SMU reading. Bitterbrush seedling survival check. Excavation of root systems at Casuse.

August 4 (Tuesday) - Excavation of root system at Flukey Spring.

August 5 (Wednesday) - Excavation of root systems at Flukey Spring. Painted weather shelter at Flukey.

August 6 (Thursday) - Met A. L. Hormay, M. W. Talbot, D. R. Cornelius, Bert Reid, George Fischer and Stan Zigler in the A.M. Went to Tulelake to get the cars serviced and picked up the remainder of the iron pegs.

August 7 (Friday) - Spent day with the inspection group in looking over the project.

August 10 (Monday) - SMU readings. Measurement of bitterbrush seedlings at Flukey Spring and Casuse.

August 11 (Tuesday) - Examined can plantings and took phenology records. Went to Bieber to check on Ceanothus cuneatus seed. Stopped at Pete Gehrig's place to look at 25-year-old seeded bitterbrush.

August 12 (Wednesday) - Excavation of mature bitterbrush roots. Went to Tulelake to pick up power pump.

August 13 (Thursday) - Excavation of bitterbrush plants.

C. to R.L.H. ✓
BOP
R.L.H.
file

August 14 (Friday) - Excavation of bitterbrush plants.

August 15 (Saturday) - Left for Tenant.

August 16 (Sunday) - Met bitterbrush seed gathering group outside of Tenant.

August 17 (Monday) - SMU. Checked survival of bitterbrush seedlings at Flukey Spring and Casuse.

August 18 (Tuesday) - Excavation of bitterbrush. Worked at Quarantine Station in the afternoon on reports.

August 19 (Wednesday) - Scouted Ceanothus cuneatus seed. Made arrangements with Ken Smith, Adin District Ranger, for inmate labor for collection.

August 20 (Thursday) - Went to Bieber to supervise collection of Ceanothus cuneatus.

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State of California
Department of Fish and Game
Project W46R-2
Game Range Restoration

CF&RES
B. O. Pearson
August 22, 1953

MONTHLY PROGRESS REPORT

August, 1953

July 20 (Monday) - Survival seedling count at Flukey. (7:00 P.M. to midnight, Flukey to Doyle).

July 21 (Tuesday) - Can readings and weeding at Doyle. Painted shelter for Bishop and checked hygrothermographs that came from Pilgrim Creek.

July 22 (Wednesday) - Set phenology stakes and readings; finished labeling stakes at Doyle. Scouted area between Honey Lake Ranch and Blinkenstaff Ranch for possible bitterbrush seed collection.

July 23 (Thursday) - Installed weather equipment except maximum thermometer at Doyle, rain gage, Foxboro soil temperature, hygrothermograph and maximum brackets. From Doyle to Susanville; contacted cooperators in aid of seed collection. Susanville to Madeline; breakdown of 72E (fan belt and condenser mount). Madeline to Flukey.

July 24 (Friday) - Madeline to Flukey. Unloaded seed and checked area for burning at Flukey. Plot ready for burning but torches had been taken to Tulelake. Rewrote diary and read current mail and quarterly report.

July 27 (Monday) - Read current mail and sent diary to Berkeley. Hubbard and I on survival count at Flukey plot 1. Prepared for burn at Flukey plot 14-A and B. Burned chemical plot at 3:20 P.M. At 3:40 P.M. burned untreated plot. Fire burned hot but no control problem. Wind varied from SW to NW at 3-4 mph. Stick 4; humidity 18; temperature 95. Held Dry Lake crew 1/2 hour overtime (6:30 P.M.) for mop-up. The half-hour used was to get tools and tanker up to standard for their fire responsibilities. Hubbard and I on patrol and mop-up until 7:00 P.M. Area checked 8:00 - 10:00 P.M. and midnight by Hubbard or myself for possible fire.

July 28 (Tuesday) - Hubbard and I took seedling survival counts at Flukey plot 1 and 2; took seedling survival count at plot 5 and 6. Hubbard and I with crew on fire call at Quarantine Station from 2:30 to 3:00 P.M. Hubbard, Dry Lake crew and I to Casuse burned plot 4-D (annual-grass untreated);at 4:05 P.M. annual-grass made a good burn, mustard and perennial grass relatively untouched. Took seedling survival at Casuse.

July 29 (Wednesday) - At Quarantine Station waiting for Fish and Game personnel (Glading and Ashley didn't show up). Spent day on preliminary work-up of seedling survival records.

ries to RLH ✓
BOP
RLH.
file

July 30 (Thursday) - Hubbard and I on root depth of plants at Flukey; put up weather station.

July 31 (Friday) - Hubbard and I on root depth of plants at Flukey. To Alturas at 1:00 P.M. to pick up end of month cost estimates. Checked Squawapple seeds on trip to Alturas.

August 3 (Monday) - Hubbard and I on seedling survival on all bitterbrush plots. In the P.M. on root depths at Casuse.

August 4 (Tuesday) - Hubbard and I at Flukey on root depth.

August 5 (Wednesday) - Hubbard and I at Flukey on root depths. Painted weather station at Flukey.

August 6 (Thursday) - At Quarantine Station; met Talbot, Hormay, Reid, Fischer and Thornton. To Tulelake for servicing and repair of vehicles; secured permission to use soil moisture equipment of California Extension Service and bought balance of stakes (2400 lbs.) to Dry Lake.

August 7 (Friday) - Waited for inspection crew at the Quarantine Station. With Talbot, Hormay, Reid and Hubbard on Game Browse Project. Project inspection.

August 10 (Monday) - Hubbard and I took height, diameter, and vigor measurements of all bitterbrush plots.

August 11 (Tuesday) - Hubbard and I took can readings and phenology for Flukey. We went to Bieber area to check on Ceanothus seed. Also stopped in Pete Gehing's place to see his bitterbrush plantings. (Seed had been collected at Glass Mt. and broadcast "hand" on 80-acre pasture about 25-30 years ago.)

August 12 (Wednesday) - Hubbard and I started digging mature bitterbrush plants; reached a hard pan at 52". To Tulelake in the P.M. for Dobbins pump and servicing of pump. Used pump to start washing bitterbrush roots.

August 13 (Thursday) - Hubbard and I spent day washing roots on mature bitterbrush plants.

August 14 (Friday) - Hubbard and I worked on mature bitterbrush plants. To Klamath Falls at 10:00 A.M. on Pearson project.

August 15 (Saturday) - To Blacks Mt. to return disc terracer plow. Picked up 600 (?) seedling protection cones.

August 17 (Monday) - Hubbard and I took seedling survival of all bitterbrush plants at Flukey. In the P.M. took 72E for repairs and general overhaul; started working up manpower for fencing of Flukey.

August 18 (Tuesday) - Worked up manpower for Flukey Spring fence. Worked up use of Modoc manpower on plot work and control burn.

August 19 (Wednesday) - Hubbard and I scouted Adin-Hat Creek country for seed collection. Made initial plans for convict work on Ceanothus collection with Adin Assistant Ranger.

August 20 (Thursday) - Hubbard and I to Adin for supervision of Ceanothus collection. Eight convicts and one GS-5 foreman used. Convict labor cost $8.75 per day per man. Checked Blacks Mt. for possible seed collection.

August 21 (Friday) - End of month report. Took 93E in for repair and maintenance and looked over some of the Extension spray work.

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Project W-6R-2

August 26, 1953
A.L.H.

JOB LIST

(For period August 25 to about December 1, 1953)

1. Prepare progress report on site preparation tests -- spraying, burning, cultivation plots -- outlining purpose, what was done, time, place, treatment, etc. and other points called for in such reports including brief pertinent comments on the reactions or results obtained to date, if any. Needed by September 15.

2. Prepare suggested plan for site preparation work proposed for next spring.

3. Lay out plots for site preparation work, after point 2 is covered.

4. Prepare plans for plantings to be made this fall and next spring. (See August 26 work plans by ALH, attached.)

5. Make the plantings alluded to in point 4.

6. Purchase and get all equipment in shape for fall planting -- drills, plows, tractors, etc.

7. Prepare progress reports on bitterbrush seedling survival and mortality (as of September 15).

   Can plantings
   Plot plantings

8. Make notes of significant reactions on all plots by December 1.

9. Prepare progress report on root growth studies (as of September 15).

10. Finish setting up all site factor stations and instruments. Surround with light fence. Protect areas within -- like area over soil moisture elements.

11. Train Fish and Game and Forest Service personnel further in handling site factor records during winter.

12. Outline plan for taking soil moisture samples (by December 1).

13. Clean about 200 lbs. of bitterbrush seed and small quantities of other seed in Berkeley by September 30.

14. Send 10 lbs. of bitterbrush fruit and 1 lb. of Peraphyllum fruit to L. Mullet, Washington Fish and Game, in August.

15. Send 10 lbs. of bitterbrush seed to Fish and Wildlife Laboratory (D. A. Spencer) in September for tetramine treatment.

16. Collect browse seeds as previously outlined.

17. Spend 10 to 14 days in Berkeley (either Hubbard or Pearson or both) starting September 14 or 21, to help prepare quarterly report, clean seed, purchase supplies and equipment, prepare plans, etc.

18. Prepare material for quarterly report.

19. Place order with Lassen Forest for preparation of routed out wooden signs for experimental areas and plots.

20. Photograph plots and pertinent points.

    Black and white
    Color

21. Get series of bitterbrush root depth penetration measurements at the Flukey Spring, Doyle and Wells Meadow areas after maximum root penetration is reached. Get three measurements on cultivated and uncultivated areas on each experimental area this fall.

Seeds planted at Doyle
Fall 11/22/53
Spring 3/19/54

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Project W46R-2

August 26, 1953
A.L.H.

STUDY PLAN

Subject: Planting methods – depth
Bitterbrush

Purpose

To get information on the effect of:

(a) Depth of planting
(b) Time of planting
(c) Plant competition (including soil moisture and other site factors)
(d) Rodents and birds

on the germination and survival of bitterbrush on three sites.

Outline of Study

1. Sites: Three — (1) Flukey Spring, (2) Doyle, and (3) Wells Meadow experimental areas. Inside fenced exclosures.

2. Seedbed conditions: Two — (1) Cultivated and (2) uncultivated.

3. Time of planting: Two — (1) Fall and (2) Spring.

4. Planting depths: Six — 0, 0.5, 1.0, 1.5, 2.0 and 2.5 inches. (Seed planted by hand)

5. Species: One — Bitterbrush (seeds).

6. Number of seed per spot: Five — Replications

7. Number of spots per depth class: Twenty — (This makes 100 seeds per depth class.)

8. Seed treatments: Four — (1) Untreated and exposed to rodents and birds; (2) untreated and screened against rodents and birds; (3) treated with tetramine and exposed to rodents and birds; (4) treated with tetramine and screened against rodents and birds. 1/

9. Total wire mesh domes needed. — 3 x 2 x 2 x 1 x 6 x 20 x 2 = 2880 (These are located at the Blacks Mt. Branch Station.)

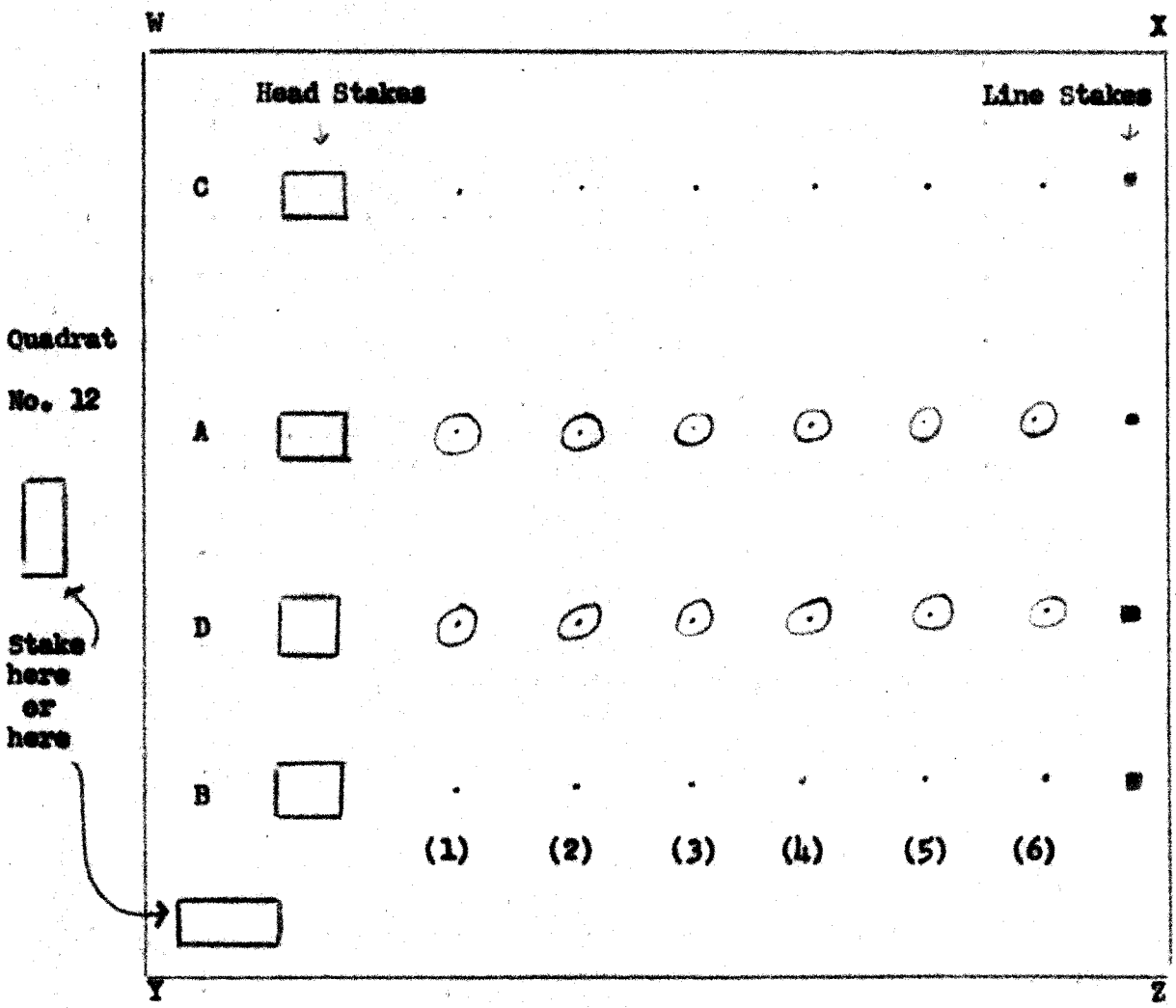
1/ With dome screen cones made of 1/4" hardware cloth.

2 - Study plan (planting methods) - 8/26/53

Plot Design

Plot = One	Area inside fence.
Subplots = Two per plot	(1) Cultivated and (2) uncultivated areas inside fence.
Blocks = Two	One for fall planting and one for spring planting.
Quadrats = Twenty per block	These are the sampling units. The four seed treatments and planting methods will be applied on each of these quadrats as diagrammed below.

Diagram of Quadrat (W, X, Y, Z)



A, B, C, D are stakes marking the treatments and planting rows.

3 - Study plan (planting methods) - 8/26/53

Stake and Treatment Legend

Stake letter	Stake color	Treatment
A	White	Untreated seed; screened
B	Yellow	" " unscreened
C	Orange	Tetramine treated seed; screened
D	Red	" " " unscreened

The treatments A, B, C, D are located at random in the four positions on each quadrat. The dots opposite the stakes represent the planting spots spaced 8" apart in both directions. The first spot is located 12" from the stake (east of stake). The circles surrounding the dots opposite A and D are wire mesh planting domes.

The seeds will be planted in spots (1) to (6) systematically in the same way for each treatment in each quadrat as follows:

Spot No.	Planting depth (in.)
1	0
2	0.5
3	1.0
4	1.5
5	2.0
6	2.5

Leave enough space between quadrats to permit examining the seed spots from a kneeling position - approximately 24 to 30 inches.

Procedure

1. Locate stake and number quadrats. Orient quadrats all in the same direction on all plots.

2. Make guide stick to mark seed spots locations between head stakes and line stakes.

3. Plant seeds (5 in each spot) as nearly as possible at the desired depths. Develop planting technique.

Records

1. Examinations: First emergence and at intervals dictated by results obtained in last year's plantings.

2. Record: (a) Number of seeds germinating in each seed spot; (b) height of dominant seedlings; (c) cause of mortality or injury of seedlings, if any; (d) other.

Make fall plantings anytime after the plots are laid out and seed and other materials are available (September or October).

Make spring plantings at a time indicated by the seeds buried in the soil to determine germination activity.

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Project W46R-2

August 26, 1953
A.L.H.

Supplement to August 26, 1953 Study Plan

Other bitterbrush plantings

(Fall of 1953; Spring 1954)

1. Bury 48 removable packets of bitterbrush seeds 2" deep in the soil on each of the three experimental areas. Withdraw a packet at weekly intervals starting February 1, 1954 and examine for germination activity.

2. Drilled and other mechanically planted plots.

(a) Flukey Spring (inside exclosure)

Plantings:	Fall and Spring
Species:	Bitterbrush
Site:	Cultivated and uncultivated
Method:	Drill 1.5" deep
Size of plot:	10' x 100'

Plots	Planting Conditions
	Cultivated site
	Fall planting (unstratified seed) Untreated seed
1	Loose seedbed - plowed this fall
2	Firm seedbed - plowed last fall
3	Packed seedbed - plowed and packed this spring
4 ↓	**Tetramine treated seed** Packed seedbed - plowed and packed this spring
	Spring planting (stratified seed) Untreated seed
5	Loose seedbed - plowed next spring
6	Firm seedbed - plowed last fall
7	Packed seedbed - plowed and packed this spring
8	**Tetramine treated seed** Packed seedbed - plowed and pack this spring
	Uncultivated site
	Fall planting
9	Untreated, unstratified seed
10	Tetramine treated, " "

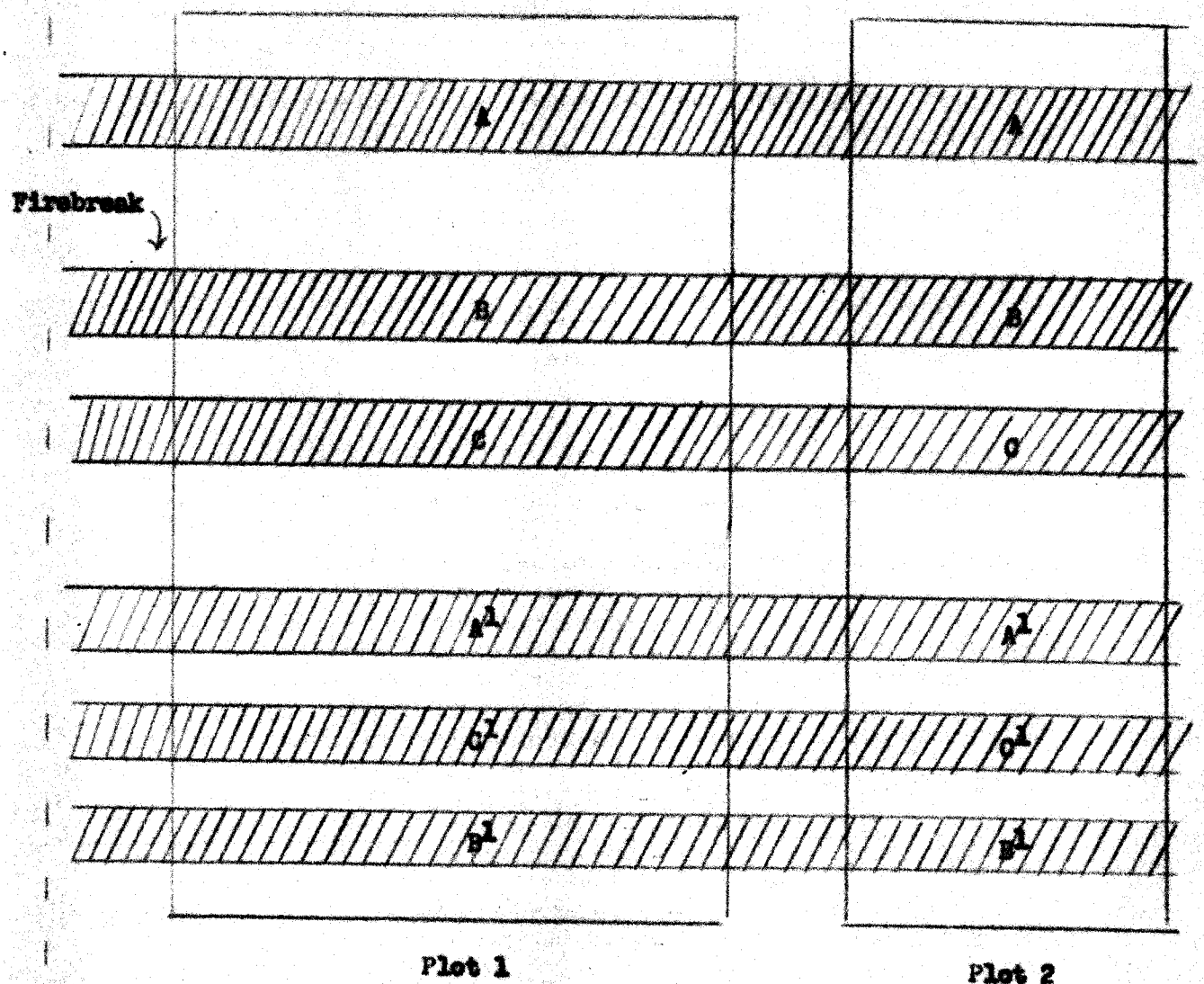
Spring planting

11	Untreated, stratified seed
12	Tetramine treated, stratified seed

Total of 12 plots -- no replications.

(b) Casuse Mt. (spray and burning plots)

Plant with bitterbrush seed as follows:



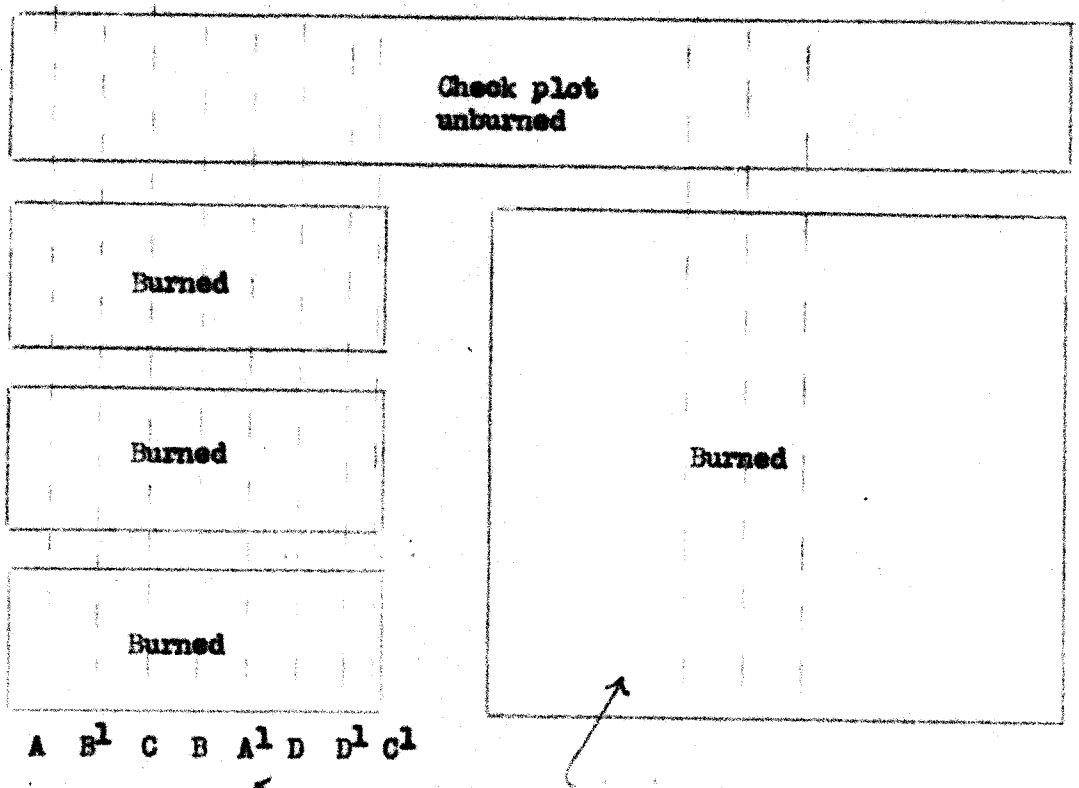
A and A^1 = 1 drill width untreated seed

B and B^1 = 1 drill width tetramine treated seed

C and C^1 = Broadcast tetramine treated seed approximately 1 drill width wide

Run the planted strips across the plots. Space strips and assign treatments at random.

(c) Doyle - burned plot



A and A^1 = Drill untreated seed

B and B^1 = Drill tetramine treated seed

C and C^1 = Broadcast untreated seed

D and D^1 = Broadcast tetramine treated seed

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State of California
Department of Fish & Game
Project W46R-2

CFR&RS
September 8, 1953

JOB PLAN

September 1 to 30, 1953

Objectives:

1. Collect seed of Cercocarpus ledifolia and Garrya fremontii.

2. Clean 200 pounds of bitterbrush fruit, 45 pounds of Peraphyllum fruit, 60 pounds of Ceanothus cuneatus fruit.

3. Continue systematic records of weather, plant phenology, soil moisture and bitterbrush seedling survival and mortality.

4. Summarize information and prepare quarterly progress report.

5. Prepare plans for fall plantings and other work.

c. to Fish & Game
RLH
BOP
RLH
file

STATE California

PROJECT W46R-2

DATE October 5, 1953

QUARTERLY PROGRESS REPORT

SURVEYS AND INVESTIGATIONS

as required by

FEDERAL AID IN WILDLIFE RESTORATION ACT

1. Title of Project: Game Range Restoration

2. Supervisors: Ben Glading, Chief, and William P. Dasmann, Senior Game Biologist, Game Management Branch, California Department of Fish and Game

3. Leaders: M. W. Talbot and A. L. Hormay

   Assistants: B. O. Pearson and R. L. Hubbard

4. Cooperating Agency: California Forest and Range Experiment Station

5. Summary report of progress during the quarter, July 1 to September 30, 1953 THIS REPORT IS NOT FOR PUBLICATION.

Purpose

The primary objective of this project is to develop cultural methods of re-establishing and extending browse species suitable for food or cover on deteriorated game ranges in California. Both native and introduced species are being considered. The work is being started in the Eastside Region of the State on deer winter ranges which extend a distance of about 500 miles from Oregon to the southern end of the Sierra Nevada mountains. These ranges are heavily deteriorated. They lie in a comparatively light snow belt, but in heavy precipitation years snow covers low growing forage and hinders the movement of the deer. Under these conditions shrubs become premium forage plants for deer because of their upstanding growth habit. Bitterbrush (Purshia tridentata) is the most important game browse in the region and is being given special attention in these studies.

Status

This project is now a little over one year old. From the two experimental plantings possible so far -- one last fall and one this spring -- a sufficient number of bitterbrush seedlings were obtained to permit observations on some of the more important factors involved in browse restoration. These seedlings are now nearing the end of their first season of

growth. However, they have not felt the depth of the dry season yet, nor experienced the effects of wintering. It will be six months before the first annual weather cycle affecting these seedlings is completed.

Of necessity the reactions observed to date are at most indicative. It will be necessary to obtain several seasons of records on many of the factors studied before a basis is provided for working out practical reseeding measures. The ultimate goal of this project is the development of direct reseeding measures that can be applied readily and with consistent success over extensive areas of rough non-arable range lands.

Generally speaking the work to date has been devoted largely to establishing experimental areas in the field (see previous quarterly reports for descriptions and locations); probing the problem to determine the more important factors involved; and settling on experimental procedures and techniques.

The general experimental approach used in this project to get at a solution of the browse restoration problem consists of identifying and getting a clear understanding of the role of the principal factors involved. These factors are outlined in general terms on page 2 of the April 1, 1953 quarterly report. This is expected to provide the basis for working out practical browse restoration methods.

General Accomplishments During Last Quarter

1. Construction of the Flukey Spring deer-livestock exclosure was completed.

2. Site factor stations on the Flukey Spring and Doyle experimental areas were brought nearer completion.

3. Seed of several browse species was collected.

4. At Flukey Spring, systematic measurements were made of the growth and mortality of bitterbrush seedlings obtained from plantings made last fall and this spring and of some related factors like plant growth and development, weather, and soil moisture.

Results

The present report deals mainly with the early indications of the effect of plant competition and soil moisture on the growth and mortality of bitterbrush seedlings on the Flukey Spring experimental area. Other activities are mentioned briefly.

Experimental Areas

Progress to date in setting up the three principal experimental areas is shown in Table 1:

Table 1.--Status of fence construction and instrumentation on the three principal experimental areas

Facility or instrument	Flukey Spring		Doyle		Wells Meadow	
	Constructed or installed	To be installed	Constructed or installed	To be installed	Constructed or installed	To be installed
Deer-livestock exclosure	x		x		x	
Weather shelter	x		x			x
Hygrothermograph	x		x			x
Maximum thermometer	x		x			x
Minimum thermometer	x		x			x
Foxboro soil thermograph		x	x			x
Rain gage		x	x			x
Snow depth gage		x		x		x
Colman soil moisture installations	x		x		x	

Installations are expected to be completed and systematic measurements started on all three areas by the start of this coming wet season.

Seed Collection

Seeds of six browse species were collected during the past quarter as indicated in Table 2:

Table 2.--Seed collected during the past quarter

Species	Amt. of field run material mainly fruit	Yield of seed or fruit after cleaning	Date of collection	Altitude	Location: Nearest landmark	Location: County
	Lbs.	Lbs.				
Wedgeleaf ceanothus (Ceanothus cuneatus)	60.0	5.0 seed	8/20-24	4500	Big Valley	Lassen
Deerbrush (Ceanothus integerrimus)	1.25	Not cleaned yet	8/28	4500	"	"
Tobacco brush (Ceanothus velutinus)	0.50	"	8/28	5600	Blacks Mt.	"
Squawapple (Peraphyllum ramosissimum)	90.0	3.0 seed	8/27	4300	Canby	Modoc
Bittercherry (Prunus emarginata)	20.0	Not cleaned	9/10	4300	Perez	"
Bitterbrush (Purshia tridentata)	386 117	106.0 seed 58.0 fruit	7/18-22	4200	Milford	Lassen

Generally speaking, this was a below average seed year and seed was obtained with difficulty. As pointed out in the first quarterly report (October 1, 1952), locating and collecting even small amounts of good seed

is time consuming and costly, especially in the poorer seed years. It would be greatly appreciated if interested field going personnel would continue to collect small amounts of seed of local native species when they run across them or to report the location of developing or ripe seed to this Station.

A high proportion of the bitterbrush seeds failed to fill out and mature properly this year. Out of a lot of 386 pounds of fruit collected, only 106 pounds of usable seed was obtained. The amount of waste and different quality seeds obtained from this lot are shown in Table 3. Barely enough seed was obtained for planned experiments.

Table 3.--Amount of seed and waste obtained from a collection of bitterbrush fruit

	Pounds	Percent
Waste		
Branches, twigs, rocks, etc.	175	45
Fruit husks	61	16
Seed		
Good quality	60	16
Fair quality	46	12
Poor or worthless	44	11
Total	386	100

Effect of Plant Competition on the Emergence and Early Growth and Survival of Bitterbrush Seedlings

The term "competition" is used here to convey the idea that plants compete with one another for survival on a given unit of ground; also, that plants in one way or another are influenced by the presence of other plants around them. The age, size, abundance and character of the species have much to do with these interactions.

There is little doubt that in a semi-arid region, such as the deer winter range problem area under study in this project, soil moisture is one of the principal factors determining growth and survival of browse seedlings. Many of the tests planned in this project, therefore, are designed to throw light on the influence of soil moisture on browse establishment. Since soil moisture is influenced strongly by the vegetation cover and soil on the soil and the character of the soil, and since the vegetation cover (the surface particularly) can be modified to a considerable extent, a knowledge of soil moisture behavior has a direct bearing on such practical reseeding measures as site and seedbed preparation, time, depth and rate of seeding and selection of species for planting. Many reseeding practices are in the end aimed at the conservation and timely use of soil moisture for maximum benefit to the planted species.

Bitterbrush plantings made on plots 1, 2 and 6 on the Flukey Spring experimental area last fall (see Table 3, January 5, 1953 quarterly report)

supplemented by hand-weeded subplots on plot 1 on July 13 this year, provided an opportunity of observing the effect of four different levels of plant competition on the emergence, growth, and survival of bitterbrush seedlings. These competition levels can be classified roughly as: 1, negligible; 2, light; 3, moderately heavy; and 4, heavy. The vegetative cover conditions corresponding to these competition levels are given in Table 4:

Table 4.--Vegetative cover on four plots[1/], Flukey Spring experimental area, September 8, 1953

Species	Species density (estimated)			
	Plot 1	Plot 1A	Plot 2	Plot 6
NATIVES				
Big sagebrush (Artemisia tridentata)	-	-	-	.180
Bitterbrush (Purshia tridentata)	-	-	-	.080
Rabbitbrush (Chrysothamnus viscidiflorus)	-	-	-	.020
Mustard (Sysimbrium sp.)	.007	-	.003	.008
Cheatgrass (Bromus tectorum)	.003	-	.003	.001
Idaho fescue (Festuca idahoensis)	-	-	-	.040
Squirreltail (Sitanion hystrix)	-	-	-	.028
Junegrass (Koeleria cristata)	-	-	-	.020
Western needlegrass (Stipa occidentalis)	-	-	-	.012
Ground smoke (Gayophytum sp.)	.003	-	.002	T
Smallflower collinsia (Collinsia sp.)	.004	-	.001	T
Others	.001	-	.001	.010
PLANTED SPECIES				
Bitterbrush (Purshia tridentata)	.012	.012	.004	.001
Crested wheatgrass (Agropyron cristatum)	-	-	.186	-
TOTAL ALL SPECIES	.030	.012	.200	.400

1/ Plot 1A Consists of four 25' x 41' subplots on Plot 1 weeded of all species except bitterbrush seedlings on July 13, 1953.

Plot 1 Plowed and drilled with bitterbrush seed at rate of approximately 5 lbs. per acre in fall of 1952. Original cover comparable to Plot 6.

1/ (Cont.)

Plot 2 Plowed and drilled to bitterbrush (about 5 lbs. per acre) and crested wheatgrass (5 lbs. per acre) in fall of 1952. Original cover comparable to Plot 6.

Plot 6 Native cover left undisturbed except drilled with same species as Plot 2.

A general picture of precipitation and air temperature on the Flukey Spring area since last fall is indicated by Weather Bureau records taken at Tulelake - some 20 miles to the north of Flukey Spring (Table 5). The period from July to mid-October is usually hot and dry and a hazard to seedling establishment.

Precipitation this past season (September 1952 to August 31, 1953) averaged a little over 2 inches above the 22-year average from 1931 to 1952, inclusive.

The following results deal with seedling responses during two periods of the season: (1) From seedling emergence on April 1 to July 13 when initial seedling mortality reached a comparatively low level; and (2) July 13 to September 8, the date of the last measurements.

Emergence

Total seedling emergence on all three basic plots (1, 2, and 6) was low, averaging only 3.8 percent of the estimated number of viable seeds planted (Table 6):

Table 6.--Emergence of bitterbrush seedlings under three conditions of plant cover, Flukey Spring experimental area

	Plot 1	Plot 2	Plot 6	Aver.
Estimated number of viable seeds sown per plot	11,900	11,900	11,900	
Number of seedlings emerging	718	477	151	
~~Precent~~ Percent emergence	6.0	4.0	1.3	3.8

Emergence was highest on the clean cultivated plot (No. 1) sown to bitterbrush, lower on Plot 2 which was also cultivated but sown with both bitterbrush and crested wheatgrass (the latter to provide competition), and last on the uncultivated plot (No. 6) which was sown with both bitterbrush and crested wheatgrass. A negligible amount of crested wheatgrass germinated on Plot 6.

Table 5.--Precipitation and air temperature, Tulelake, California

	1952				1953								Season
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Total
Air temperature (°F)													
Aver. daily max.	80.2	72.8	50.5	38.0	44.8	49.5	51.3	57.6	58.5	67.7	85.3	78.6	
Aver. daily min.	38.6	29.2	15.3	16.8	26.4	21.9	22.3	26.4	31.9	36.8	44.1	42.7	
Precipitation (in.)													
1952-53 season	.40	.05	.46	2.07	1.56	1.05	1.14	.73	2.27	1.37	0.0	1.07	12.17
22-year aver., 1931 to 1952, inc.	.48	1.04	.98	1.19	.98	1.06	.82	1.04	1.14	.83	.28	.13	9.97 1/

1/ Total seasonal precipitation at Flukey Spring is believed to average about 2.0 inches higher.

The principal factors believed to be responsible for the low emergence on all plots are: (1) Inadequate or lack of site preparation; (2) inadequate control of planting depth; (3) take of seeds by rodents and unfavorable moisture conditions near the surface of the soil at times during germination.

On the cultivated sites plowing last fall resulted in a loose seedbed which could not be compacted satisfactorily prior to drilling. The only drill obtainable in time for this first planting was not equipped with depth bands. Because of these two factors many of the seeds were planted too deep or too shallow and failed to germinate or emerge. There is little doubt that with better drilling and soil compaction much better results can be obtained. On the uncultivated plot the drill discs were forced out of the soil much of the time in riding over grass tufts, shrub crowns, and other obstructions, and a large portion of the seeds were cast on the soil surface. Rodents and unfavorable weather took an unknown toll of seeds and young seedlings. On the basis of results obtained in can plantings reported in the last quarterly report, this toll could be considerable. Insect damage was slight.

Growth

Heavy plant competition greatly stunted the growth of seedlings. Compared with seedlings under light competition, seedlings under heavy competition grew less than a third as large and were much less vigorous. Under negligible competition seedlings reached an average height of 4.9 inches and a crown diameter of 2.3 inches by September 8, compared with a height of only 0.7 inches and a diameter of 0.6 inches of seedlings under heavy competition (Table 7). The stress of competition apparently was felt by the seedlings throughout their growth to date judged by the growth of the tops.

The roots of plants under light competition were larger than the roots of plants under heavy competition. Under the former the roots penetrated to a depth of about 36 inches by September 8 and were heavily branched from about 9 inches below the soil surface down the full length of the roots. Root growth in relation to top growth is shown in Figure 1. The roots of plants under heavy competition penetrated almost as deeply into the soil -- about 30 inches -- but were very spindly. They consisted mainly of a single thread-like filament which branched sparingly and mostly in the last 6 inches of the root.

Table 7.--Size of bitterbrush seedlings growing under four levels of plant competition on the Flukey Spring experimental area

Competition level	Plot No.	Size of seedlings on two dates			
		July 8, 1953		Sept. 8, 1953	
		Ht. in.	Diam. in.	Ht. in.	Diam. in.
1. Negligible 1/	1A	2.0	1.2	4.9	2.3
2. Light	1	2.1	1.3	4.4	2.1
3. Mod. heavy	2	1.5	0.9	1.9	0.9
4. Heavy	6	1.2	0.6	1.4	0.6

1/ Competition was negligible after July 13 when the plot was weeded. Until then the competition was the same as on Plot 1.

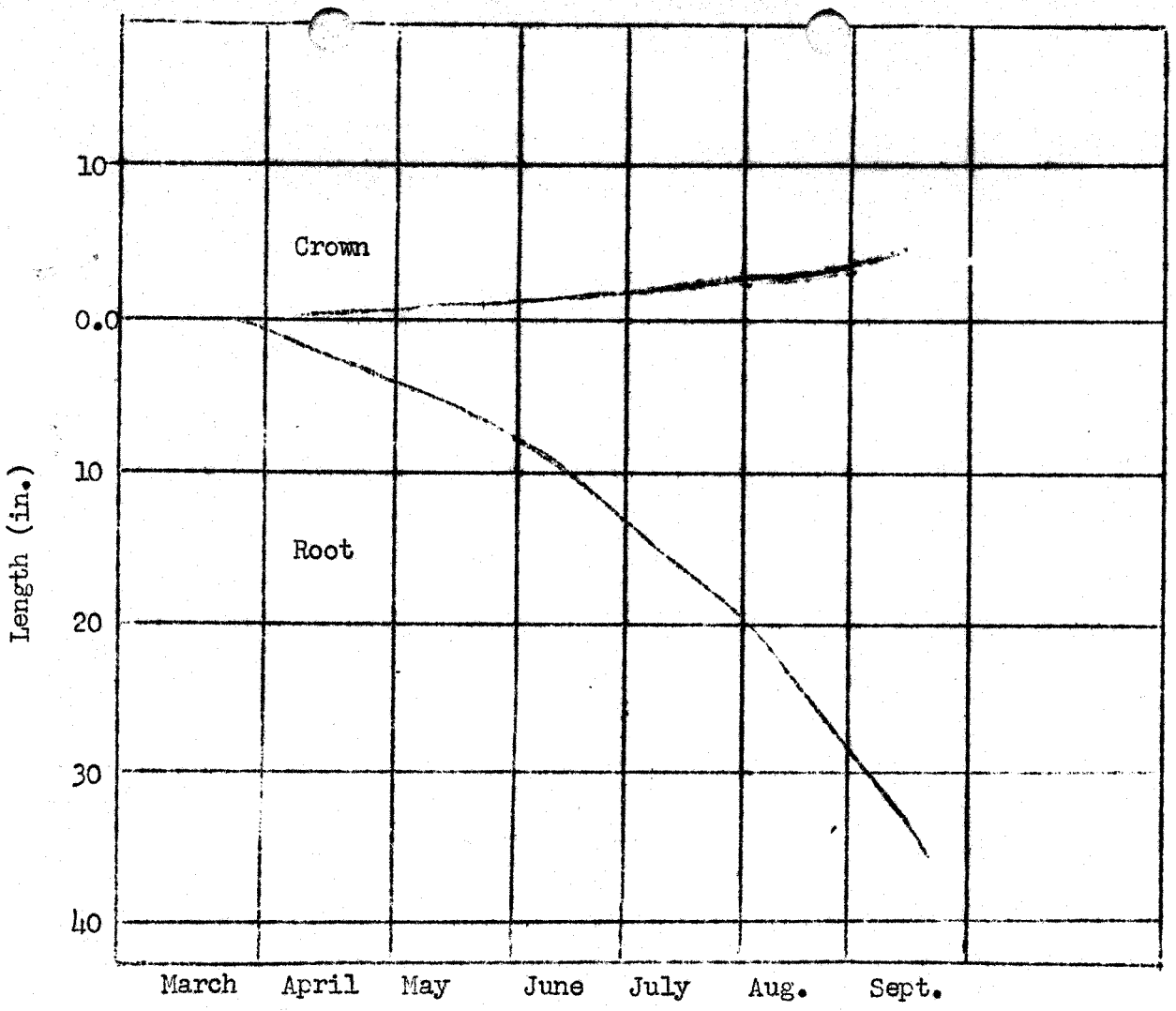


Figure 1.--Growth of crown and root of bitterbrush seedlings under light plant competition. Flukey Spring experimental area.

Mortality

The average mortality of seedlings on all four plots up to September 8 averaged about 29 percent. The mortality on the heavy cover plot (No. 6) was about 44 percent, on the moderate cover plot (No. 2) 31 percent, and on the negligible and light cover plots (1A and 1) 21 percent and 20 percent, respectively. Seedling mortality to date was about twice as great under the heavy vegetation cover as under the light or negligible one.

About two-thirds of the total mortality occurred from April 1 to July 13 and one-third from July 13 to September 8.

The die-off during the first period was about the same on all plots and averaged 18 percent. In the second period it averaged less -- about 13 percent.

In the latter part of this period the mortality rate appeared to reach a low, more or less constant level. The seedlings on all plots seemed to be hanging on. It was rather impressive to see how tenaciously the stunted, weak looking seedlings on the uncultivated plot clung to life. No doubt they were feeling the stress of soil moisture deficiency. Minimum soil moisture conditions have not been reached yet on these plots.

A picture of trends in soil moisture under light and heavy vegetative covers is indicated by soil moisture index values obtained from the Colman soil moisture installation (Figure 2). To simplify the graph, trends are shown for only three of eight soil levels at which measurements are being taken. These indices will be correlated with actual soil moisture during the coming wet and dry seasons. They indicate soil moisture trends as they stand. It is apparent that soil moisture in the zone occupied by seedling roots is reduced earlier and more heavily under the heavy vegetative cover than under the light cover.

The early results covered in this report emphasize the need for proper site preparation -- to reduce plant competition and to provide a suitable seedbed for planting. They point to the importance of proper methods of planting. Attention to these factors will yield more and larger seedlings, reducing planting costs and the time required to obtain a usable stand of browse.

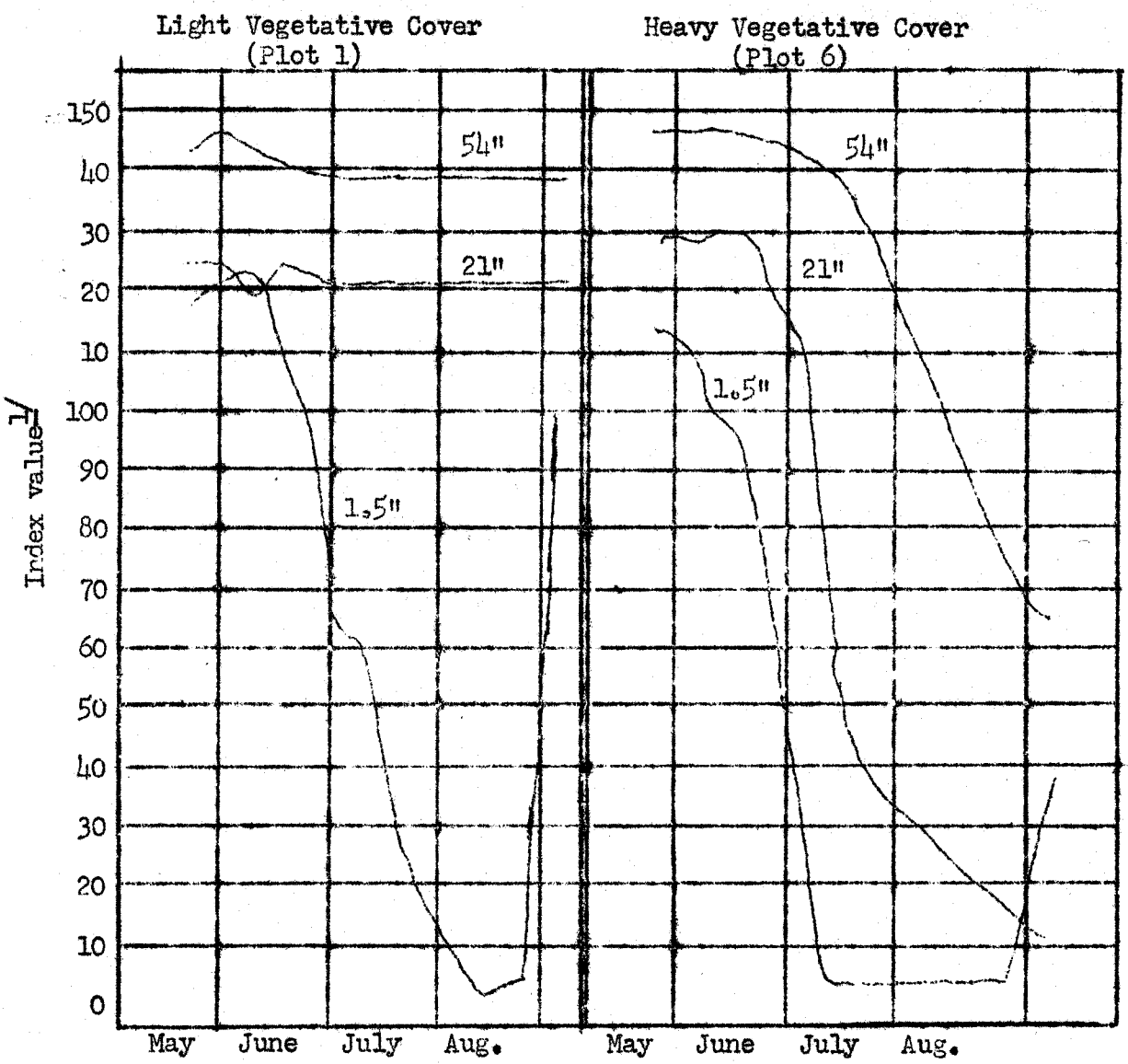
SUBMITTED BY

M. W. Talbot
Project Leader

APPROVED BY
CALIFORNIA DEPARTMENT OF FISH AND GAME

By _____
Chief, Game Management Branch

DATE _____



1/ 120-150 approximate range of high soil moisture.
0-30 approximate range of low soil moisture.

Figure 2.--Trend of soil moisture indices under light and heavy vegetation covers.

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Department of Fish and Game
Project W-46R-2

CF&RES
B. O. Pearson
October 5, 1953

STUDY PROGRESS REPORT

Subject: Species - bitterbrush germination

Three 100 bitterbrush samples were taken from the Grade I bitterbrush seed collected at Milford in July, 1953. The embryos were extracted and germinated in Petrie dishes. Germination was as follows:

Sample	Total seed	No. Total germ.	% Total germ.	No. Bad 1/ seed	% Bad seed	No. Non 2/ germ.	% Non germ.
1	100	70	70	10	10	20	20
2	100	67	67	13	13	20	20
3	100	70	70	13	13	17	17
Total	300	207	69	36	12	57	19

1/ No embryo in seed.
2/ Embryos extracted but did not germinate.

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State of California
Department of Fish and Game
Project W46R-2
Game Range Restoration

CF&RES
R. L. Hubbard
October 6, 1953

MONTHLY PROGRESS REPORT

September, 1953

August 24 (Monday) - Took seedling survival records and soil moisture records.

August 25 (Tuesday) - Went to Tulelake to check on equipment. Took seedling survival records at Casuse.

August 26 (Wednesday) - Went to Crowder Flat and Canby for collection of squawapple seed.

August 27 (Thursday) - Canby - squawapple seed collection.

August 28 (Friday) - Collected Ceanothus integerrimus on Bieber grade; C. velutinus and Arctostaphyllos patula at Blacks Mt.

August 29 (Saturday) - Blacks Mt.

August 30 (Sunday) - Blacks Mt.

August 31 (Monday) - Seedling survival check at Flukey Spring and Casuse.

September 1 and 2 (Tuesday and Wednesday) - Excavation of mature bitterbrush root penetration stopped at 36" - top of hardpan.

September 3 (Thursday) - Spent day with Hormay, talking over plans for this fall.

September 4 (Friday) - Spent day on seedling growth and mortality report.

September 8 (Tuesday) - Took seedling survival and growth records and soil moisture records.

September 9 (Wednesday) - Worked on seedling mortality report.

September 10 (Thursday) - Worked on soil moisture records.

September 11 (Friday) - Started fencing weather station.

September 14 (Monday) - Seedling survival check, soil moisture records.

September 15 (Tuesday) - Finished fencing weather station. Yellow Bluff fire in afternoon and evening.

September 16 (Wednesday) - Root excavation of bitterbrush seedlings at Flukey Spring.

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September 17 (Thursday) - Continued root excavation. Went to Tulelake to check on soil thermograph.

September 18 (Friday) - Continued root excavation.

September 21 (Monday) - Left Modoc 7:30 A.M., arrived Doyle 12:30 P.M. Checked on can plantings at Doyle, and read soil moisture units. There has been considerable rabbit damage to the bitterbrush seedlings. Left Doyle at 1:45 P.M.; arrived Berkeley 9:30 P.M.

September 22 (Tuesday) - Talked over outline for quarterly progress report.

September 23 (Wednesday) - Cleaned seed at Gill tract.

September 24 (Thursday) - Cleaned seed at Gill tract.

September 25 (Friday) - Quarterly progress report.

September 28 to October 2 (Monday to Friday) - Quarterly progress report.

Summary

1. Continuedtaking systematic records of seedling survival and growth, and soil moisture.

2. Collected seed from *Ceanothus velutinus*, *C. integerrimus*, *Arctostaphyllos patula* and *Peraphyllum ramosissimum*.

3. Did considerable root excavation work.

4. Fenced in weather stations at Flukey Spring.

5. Helped prepare quarterly progress report.

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Game Range Restoration

CF&RES
B. O. Pearson
October 6, 1953

MONTHLY PROGRESS REPORT

August 23 to September 20, 1953

August 23 (Sunday)

August 24 (Monday) - Hubbard and I took seedling survival count at Flukey Spring.

August 25 (Tuesday) - Hubbard and I to Tulelake for 93E and to pick up equipment. Seedling survival at Casuse Mt.

August 26 (Wednesday) - Hubbard and I to Crowder Flat and Canby for Squaw-apple fruit collection.

August 27 (Thursday) - Hubbard and I to Canby for Squawapple fruit collection (total collection 95 lbs.). Timber Mt.

August 28 (Friday) - Annual leave.

August 31 (Monday) - Hubbard and I on seedling survival count at Flukey and Casuse.

September 1 (Tuesday) - Hubbard and I on extraction of mature bitterbrush.

September 2 (Wednesday) - Hubbard and I on extraction of matire bitterbrush-root penetration to hard pan 36". Hormay arrived at 5 P.M.

September 3 (Thursday) - Hormay, Hubbard and I spent day making plans for fall work.

September 4 (Friday) - Spent day on seedling growth.

September 5 (Saturday) - To Tulelake for adding machine and tentative rodent eradication work.

September 7 (Monday) - Holiday.

September 8 (Tuesday) - Hubbard and I took seedling survival records.

September 9 (Wednesday) - Hubbard and I spent day on seedling mortality and height growth.

September 10 (Thursday) - Calculated height growth of bitterbrush plants. Hubbard and I plotted soil moisture curves.

September 11 (Friday) - Left for Berkeley in 93E. Arrived at 4 P.M.

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September 14 (Monday) - Spent morning in office catching up on current reading. In the afternoon gathered materials to start cleaning seed.

September 15 (Tuesday) - Finished getting materials for seed cleaning and started crushing and washing squawapple.

September 16 (Wednesday) - Continued seed cleaning. To San Francisco for seed screen 12/64" diameter.

September 17 (Thursday) - Continued seed cleaning.

September 18 (Friday) - Continued seed cleaning.

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Game Range Restoration

October 19, 1953
A.L.Hormay

STUDY PLAN

Subject: Supplemental dome plantings, Fall, 1953

Experimental Areas (inside exclosures)	Bitterbrush (fruit)	Ceanothus cuneatus (seed)	Peraphyllum (seed)
Flukey Spring	X	X	X
Doyle		X	
Wells Meadow		X	

Comparisons	Planting depth (in.)
Bitterbrush fruit	
Untreated, uncovered Tetramine treated, uncovered Untreated, covered Tetramine treated, covered	each at 1½", 1" and ½"
5 per spot, 20 spots each	Total spots 20 x 12 = 240
Ceanothus cuneatus	
As above for bitterbrush but plant at following depths.	1", ½", ¼"
Peraphyllum	
As above for bitterbrush. Same depths.	

Use planting design as set up in study plan for bitterbrush seed, dated August 26, 1953.

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CF&RES
A. L. Hormay
March 3, 1954

STUDY PLAN
Planting Method –
Subject: Reseeding field trial

Purpose

To try promising spring seeding methods with bitterbrush (Purshia tridentata) and buckbrush (Ceanothus cuneatus).

Background

Recent seed germination results and other information obtained in the field encourage the thought that sufficient information is at hand to effect successful spring seedings of Purshia and Ceanothus. The present trial is being made simply to check this point.

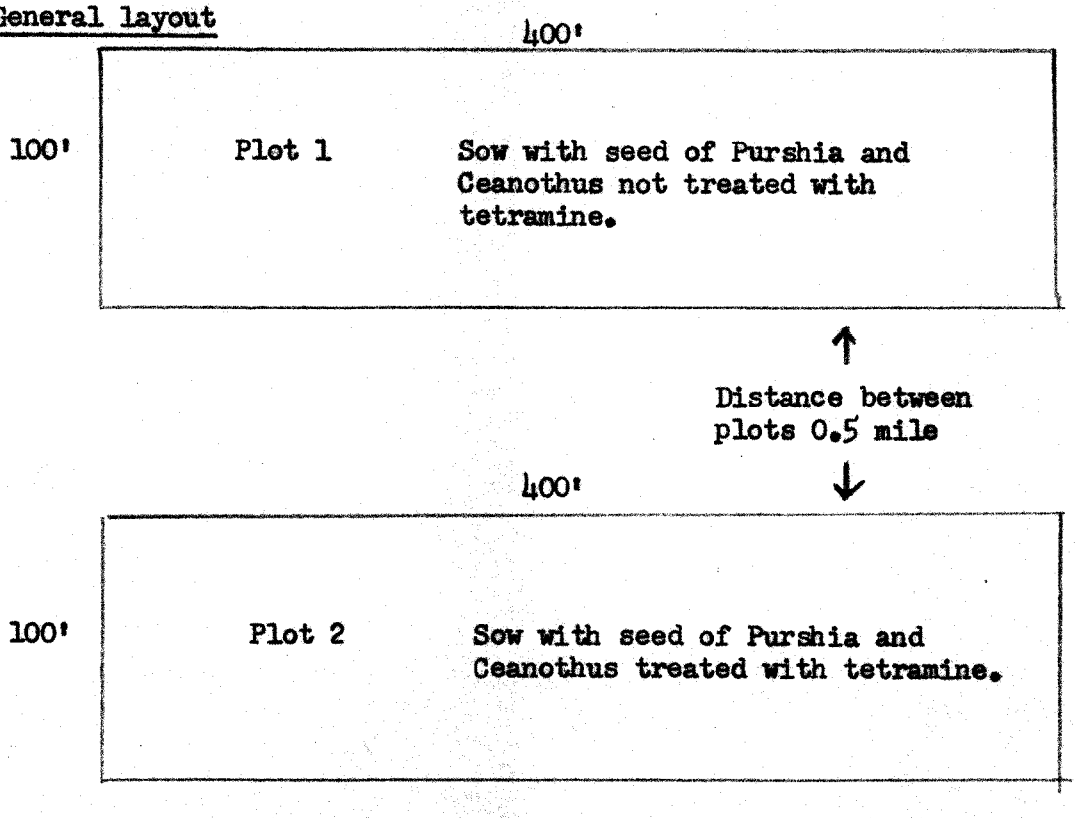
The trial will be carried out on two plots on the Mears Burn of the Flukey Spring experimental area, on the Modoc National Forest. Both will be sown with Purshia and Ceanothus. However, the seed on one plot will be treated with tetramine in an attempt to reduce seed and seedling destruction by rodents.

Plots

Size and shape

Each about 1 acre; approximately 100 feet wide and 400 feet long. Can be irregular in shape to get around rock and other obstacles. Mark boundaries with several fence posts.

General layout



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2 - Study Plan by ALH - 3/3/54

Seed and Seed Preparation

Purshia	Use seed lot No. GB
Ceanothus	Use seed lot No. GB

The seeds of the species to be sown on both plots 1 and 2 will be treated to promote germination. The seeds to be sown on plot 2 will be treated with tetramine in addition.

Treatment of Seeds for Plot 1

Purshia

Soak seed in 3% thiourea for 30 minutes at room temperature; then dry seed at room temperature for a day or more under a fan.

Ceanothus

Place seed in boiling water for 10 seconds; remove and soak in 3% thiourea at room temperature for 1 hour. Dry at room temperature for a day or more under a fan.

Treatment of Seeds for Plot 2

Purshia

Treat as for plot 1 but add tetramine to the thiourea at rate of 0.5 grams per gallon of solution.

Ceanothus

Treat as for plot 1 but add tetramine to the thiourea at rate of 0.5 grams per gallon of solution.

Rate of Planting

Purshia	3 lbs. per acre
Ceanothus	1/2 lb. per acre

Total seed needed for two plots:

Purshia	6 lbs.
Ceanothus	1 lb.

Weigh out the seeds to be sown on each plot.

Site Preparation

Just prior to seeding, disc the seedbed sufficiently to destroy most plant competition. ?

3 - Study Plan by ALH - 3/3/54

Method of Planting

Ceanothus

Broadcast treated seeds on disced ground surface. Mix seed with soil, sand, or rice hulls so it can be spread evenly. Cover seed by smoothing ground with a chain drag. Try to get about 0.5 inch coverage of the seed. Then pack soil with a roller covering the area only once.

Purshia

Drill the bitterbrush seed into the packed seedbed to a depth of about 1 inch.

Plant in moist soil. Time planting accordingly.

Seed Viability

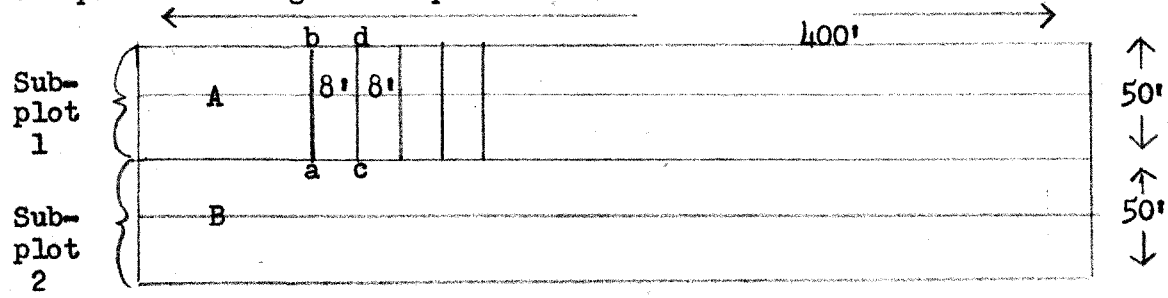
Save 500 to 1000 seed of each type of seed sown for laboratory checks on seed viability.

Photographs

Take black and white and color photographs of both plots from set hubs before and after seedbed preparation and planting.

Measurement of Results

The success of the trial will be judged in terms of seedling germination based on the number of viable seeds planted. On each plot seedling counts will be made but once, about June 15, 1954. The total number of germinated seedlings will be counted on each of 100 foot-square quadrats distributed on each plot according to the plan outlined below:



Establish two base lines A and B on each plot. Set 50 short lath stakes 8 feet apart along each base line. Quadrats used for seedling counts will be along lines a-b, c-d, etc. extending to the edges of the 50 foot wide subplots at right angles to the base line. Select two quadrat positions for each line by selecting two numbers from 1 to 50 at random. Assume position number 1 on the line to be at a. and position 50 at b. Locate the quadrats in these positions.

Count all seedlings that emerge and make a separate record of those alive and dead at the time of examination.

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CF&RES
B. O. Pearson
October 24, 1953

STUDY PLAN NO. 3

Subject: Site Preparation and Maintenance - Chemicals

1. Introduction:

See Annual Work Plan 1952; General Plan, January 15, 1953; Line of Work Study Plan: Chemical Control of Plants, November 24, 1952; and Study Progress Report: Site Preparation and Maintenance - Chemical Sprays, April 15, 1953.

Several types and kinds of chemicals have been successfully used to control or reduce different classes of vegetation. However, none of the tests have been specifically directed to reduce the vegetation as a method for preparing sites for seeding of browse species.

The plan of work is to initially try a number of the most promising chemicals which are now available or may become available at some future date. Chemicals which give some definite indication of satisfactorily reducing the vegetation will be subjected to further and more intensive trials in order to obtain the most efficient results from their application. Accordingly, this study will be supplemented from time to time as the results of tests become available.

2. Purpose of Study:

The purpose of the study is to determine the effects of chemical sprays on reducing or controlling vegetation on browse reseeding sites.

3. Outline of Study:

a. Sites: Two

(1) Flukey Spring

(a) Sagebrush type

(b) Perennial - annual type

(Mears Burn area)

(2) Casuse Mountain

Cheatgrass type

b. Time of application:

(1)	Sagebrush	3- to 4-inch stem growth on lead branches on sagebrush
(2)	Annual - cheatgrass	Preflowering of cheatgrass
(3)	Perennial - annual	Preflowering of cheatgrass

c. Types and kinds of chemicals:

(1) Foliage herbicides

(a) 2,4-D Butyl and low volatile esters

(b) 2,4,5-T

(c) MH-30 (Maleic hydrazide)

(d) TCA (Trichloroacetic acid)

(2) Soil sterilants

(a) IPC (N-phenyl isopropyl carbamate)

(b) IPC Cl. (3 chloroisopropyl carbamate)

(c) CMU (p-chlorophenyl dimethylurea)

(3) Desiccators

PCP (Na salt of pentachlorophenol)

d.	Method of application: One	Spray from tractor mounted boom
e.	Size of plots: 0.1 acre	20 feet by 218 feet with 20 foot space between treatments
f.	Specific details of application:	See Table 1
g.	Diagram of field layout of plots:	See Table 1
h.	Vegetation sampling procedure: M & S No. 4	Modified as follows: (See page 4 for details)
i.	Time of sampling: Two	1953 and 1954 in early summer

Table 1.--Diagram of field layout and specific details of application

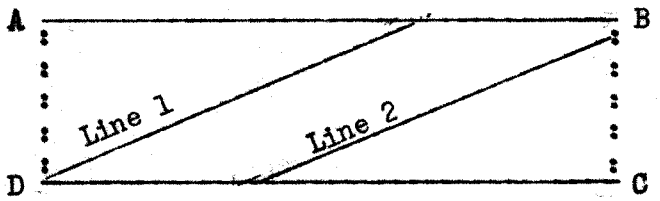
A DIAGRAM OF FIELD LAYOUT					B SPECIFIC DETAILS OF APPLICATION						
					Spray Formulation (Per Acre Basis)						
Area	Type	Plot No.		Chemical	Chemical (Lbs.)	Oil (Gal.)	Total 1/ Solution (Gal.)	Emulsifier (Ounces)	Emulsifier Kind	Jet Size	Boom Height (Inches)
Flukey Spring	Sagebrush	13	A	2,4-D butyl ester	2	1	10	12	Antrox A400	067	60
			B	2,4-D low volatile ester	2	1	10	12	Antrox A400	067	60
			C	2,4,5-T	3	1	30	12	Antrox A400	02	60
			D	Check (No treatment)							
			E	IPC Cl. (3 chloroisopropyl carbamate)	6	5	40	16	Antrox A400	03	60
			F	MH 30 (Maleic hydrazide)	8	--	40	3	Dreft	03	60
			G	PCP (Na salt pentachlorophenol)	15	20	40	None	--	03	60
	Perennial - Annual (Mears Burn)	15	A	2,4-D butyl ester	2	1	30	12	Antrox A400	03	24
			B	2,4,5-T	3	1	30	12	Antrox A400	02	24
			C	IPC Cl.	6	5	40	16	Antrox A400	03	24
			D	MH 30	8	--	40	3	Dreft	03	24
			E	Check (No treatment)							
Casuse Mountain	Cheatgrass	3	A	2,4-D butyl ester	2	1	10	12	Antrox A400	067	24
			B	2,4-D low volatile ester	2	1	10	12	Antrox A400	067	24
			C	2,4-D butyl ester	2	1	40	12	Antrox A400	03	24
			D	2,4,5-T	3	1	30	12	Antrox A400	02	24
			E	Check (No treatment)							
			F	MH 30	8	--	40	3	Dreft	03	24
			G	IPC (N-phenyl isopropyl carbamate)	6	5	40	16	Antrox A400	03	24
			H	TCA (trichloroacetic acid)	9	--	40	--	Antrox A400	03	24
			I	CMU (P-chlorophenyl dimethylurea)	8	--	40	--	--	TT 6503 (Slotted seive)	24
			J	Check (No treatment)							
			K	PCP	15	20	40	--	--	03	24
			L	2,4-D butyl ester	2		40	12	Antrox A400	03	24
			M	IPC Cl.	6	5	40	16	Antrox A400	03	24

1/ Water added to bring solution to specified amount.

j. Sampling procedures:

Two line transects, each 132' (2 chains) long will extend diagonally and parallel through the plot. Line 1 will start at corner D and extend 132' to a point along line A - B. Line 2 will start on line C - D and end on corner B. (See diagram below). Quadrats and belt transects will be spaced on these lines according to Methods and Specifications No. 4.

Diagram of Plot Transects



cc: A. L. Hormay
E. C. Nord
B. O. Pearson
R. L. Hubbard
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Game Range Restoration

CF&RES
A. L. Hormay
November 2, 1953

STUDY PLANS

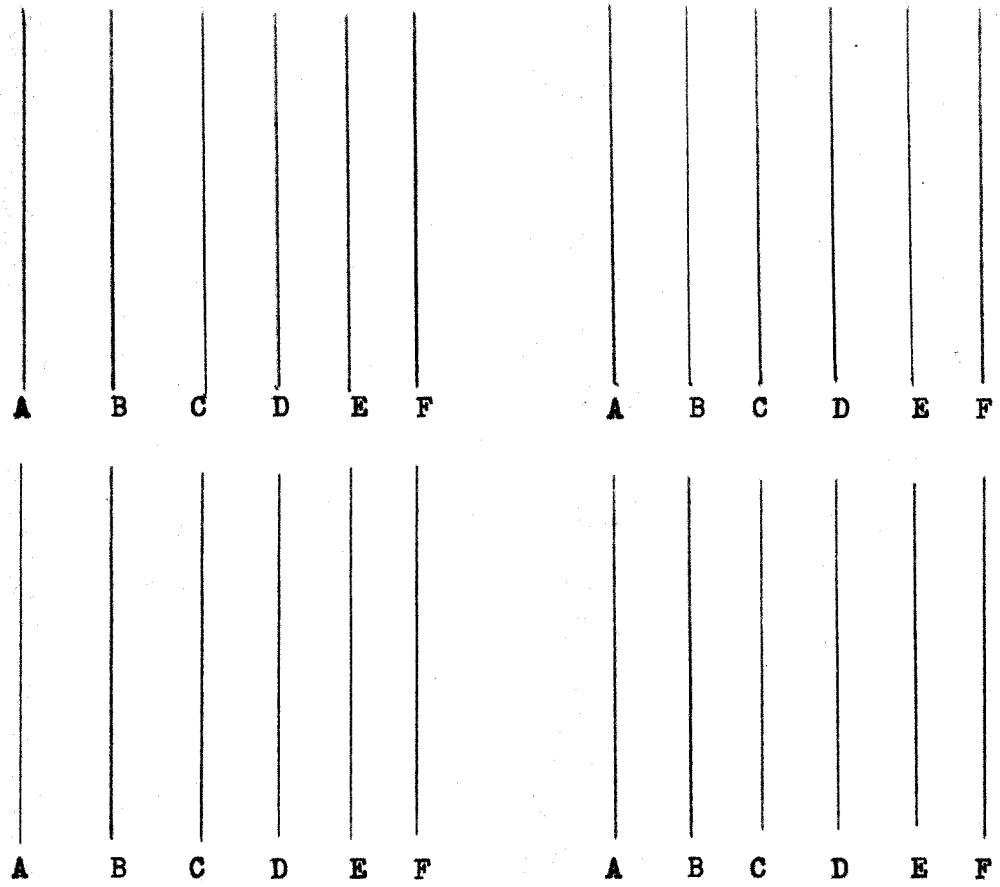
Subject: Species – *Site adaptability*

Two strains of bitterbrush -- one collected near Dubois, Idaho and the other near Boise, Idaho -- are to be planted inside the Flukey Spring exclosure this fall as follows:

Seedbed . . . . . Cultivated, firm.

Planting depth . . . . . 1 inch

Planting layout . . . . . 4 rows, 25 seed spots per row. Distance between rows about 25 feet. This will permit planting other species in between these rows if they become available. See diagram below.



A = Rows of bitterbrush strain 1
B = Rows of bitterbrush strain 2
C = Rows of species X strain 1
D = Rows of species Y strain 4
etc.

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Distance between rows . . . . . 2 feet

Distances between seed spots . . . 1 foot

Seeds per spot 5

Protection . . . . . Screen domes

Collection data on bitterbrush seed:

Dubois, Idaho

Seed collected August 4, 1953 at U. S. Sheep Experiment Station, from plants which sprouted following 1939 burn.

Boise, Idaho

Seed collected from large upright shrubs on lower part of Boise Ridge, 2 miles north of Boise, July 9, 1953. SW exposure, granite soil, 3300 foot elevation, approximately 14" precipitation annually.

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CF&RES
B. O. Pearson
November 15, 1953

STUDY PLAN NO. 5

Subject: Site Preparation and Maintenance - Chemicals (Grass Killers)

1. Background:

See Annual Work Plan 1952; General Plan, January 15, 1953, Line of Work Study Plan: Chemical Control of Plants, November 24, 1952; Study Progress Report: Site Preparation and Maintenance - Chemical Sprays, April 15, 1953; and Study Plan: Site Preparation and Maintenance - Chemicals, October 24, 1953.

Initial tests of several chemical sprays made in the summer of 1953 show that some of the chemicals have had some effect on the vegetation, particularly on the grasses. The following chemicals used in these tests gave some leads which indicate they should be given further and more extensive trials: CMU, IPC Cl., and TCA. In addition, a new chemical, Dalapon (sodium salt a, a, dichloropropionate), a Dow Chemical Company product, has been recommended by workers for its possible use in controlling cheatgrass. A small quantity sufficient for some trials has been made available to the project for experimental purposes.

2. Purpose of Study:

The purpose of the study is to determine the effects certain chemical sprays, applied at different rates and dates, have on controlling vegetation on browse planting sites. Special attention will be directed to the effects the chemicals have on reducing or eliminating cheatgrass as well as other classes of plants.

3. Outline of Study:

a. Sites: two

(1) Casuse Mountain (Plot 5)

(2) Flukey Spring - Mears burn (Plot 17)

b. Vegetation types: two

(1) Cheatgrass - annual weeds

(2) Perennial grass - annual weeds

c. Period of study: two years — 1953 and 1954

d. Number of applications: four

(1) Fall

(2) Early spring

(3) Mid-spring

(4) Late spring

e. Number of chemicals: four — CMU, IPC Cl., TCA, and Dalapon

f. Number of replications: one — Replications between sites.

g. Size of subplot: 0.1 acre — 20 feet x 218 feet (total for each site, 600 feet x 218 feet)

h. Rates of application per acre (Active ingredients):

(1) CMU, 8 pounds per acre

(2) IPC Cl., 6 pounds per acre

(3) TCA, 9 pounds per acre

(4) Dalapon, 2 and 4 pounds on annual type; 4 and 6 pounds on perennial type

i. Solutes: one — Water, 40 gallons solute per acre

j. Method of application: one — "Spray Rite" sprayer mounted on farm tractor.

k. Height of boom: — 24 inches above ground

l. Method of sampling: M & S No. 4 — Casuse Mountain - annual grasses and forbs; Mears burn - perennial grasses and annual grasses and forbs.

m. Time of sampling: 1955 and 1956 — Late spring as cheatgrass leaf tips dry on untreated plots. (Mid-May to early June)

n. Total number of subplots: 50 — 25 subplots per site: 20 chemical sprays, 5 checks

o. Diagram of field layout — See Table 1

p. Details of application — See Table 1

Table 1.--Diagram of field layout and details of application, Casuse Mountain (Plot 5) Flukey Spring - Mears Burn (Plot 17)

SUBPLOT		CHEMICAL	RATE 1/	TIME 2/	SURFACTANT		JET NO.	STRAINER
Casuse Mountain	Mears Burn				Kind	Rate		
		CMU	8	1	--	--	#2 Monarch Nozzle	Slotted seive
		CMU	8	2			#2 Monarch Nozzle	Slotted seive
		CMU	8	3			#2 Monarch Nozzle	Slotted seive
		CMU	8	4	--	--	#2 Monarch Nozzle	Slotted seive
		Check						
		IPC Cl.	6	1	Ipegal 630	3/	No. 3 TT	Screen, 50 mesh
		IPC Cl.	6	2	Ipegal 630	3/	No. 3 TT	Screen, 50 mesh
		IPC Cl.	6	3	Ipegal 630	3/	No. 3 TT	Screen, 50 mesh
		IPC Cl.	6	4	Ipegal 630	3/	No. 3 TT	Screen, 50 mesh
		Check						
		TCA	10	1			No. 3 TT	Screen, 50 mesh
		TCA	10	2			No. 3 TT	Screen, 50 mesh
		TCA	10	3			No. 3 TT	Screen, 50 mesh
		TCA	10	4			No. 3 TT	Screen, 50 mesh
		Check						
	- - -	Dalapon	2	1	Tide	4/	No. 3 TT	Screen, 50 mesh
	- - -	Dalapon	2	2	Tide	4/	No. 3 TT	Screen, 50 mesh
	- - -	Dalapon	2	3	Tide	4/	No. 3 TT	Screen, 50 mesh
	- - -	Dalapon	2	4	Tide	4/	No. 3 TT	Screen, 50 mesh
		Check						
		Dalapon	4	1	Tide	4/	No. 3 TT	Screen, 50 mesh
		Dalapon	4	2	Tide	4/	No. 3 TT	Screen, 50 mesh
		Dalapon	4	3	Tide	4/	No. 3 TT	Screen, 50 mesh
		Dalapon	4	4	Tide	4/	No. 3 TT	
		Check						
- - -		Dalapon	6	1	Tide	4/	No. 3 TT	Screen, 50 mesh
- - -		Dalapon	6	2	Tide	4/	No. 3 TT	Screen, 50 mesh
- - -		Dalapon	6	3	Tide	4/	No. 3 TT	Screen, 50 mesh
- - -		Dalapon	6	4	Tide	4/	No. 3 TT	Screen, 50 mesh
		Check						

1/ Rate: Active chemical in pounds per acre.

2/ Time: 1 - Fall; 2 - Early spring; 3 - Mid-spring; 4 - Late spring.

3/ Ipegal to be added if emulsifying effect needed

4/ Add Tide as wetting agent as indicated by dipping cheatgrass leaf in solution to obtain uniform film over surface.

3 - Study Plan No. 9A by BOP - 11/15/53

4. Method and procedures:

The dates of spraying will depend upon the vegetative growth stage of cheatgrass. The following will serve as a general guide for each series of application:

a. Late fall before cheatgrass has germinated (October to November)

b. Early spring before start of spring growth (Mid-March)

c. Mid-spring when cheatgrass has 1 to 2 inch height growth (mid-April to early May)

d. Late spring after all the cheatgrass seedheads have appeared (mid-May to early June)

Mix a sufficient quantity of solution to allow 4 gallons to be applied on each subplot. The quantity actually applied can be determined to the nearest 0.1 gallon by means of the Hershey water meter. The pressure used in the initial tests was 28 pounds per square inch. However, this may require some adjustment depending on operating conditions like speed of the tractor as affected by vegetation and amount of rock on the ground in order to obtain the correct application rate.

Record the following conditions at time of spraying:

a. Air temperature

b. Wind velocity and direction

c. Soil moisture conditions

d. General weather conditions prevailing prior to and for one day after spraying.

e. Personnel and equipment assisting and present at spraying operations

cc: A. L. Hormay
E. C. Nord
B. O. Pearson
R. L. Hubbard
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CF&RES
B. O. Pearson
R. L. Hubbard
November 20, 1953

MONTHLY PROGRESS REPORT

October 20 to November 20, 1953

Filed with Pearson's

reports.

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State of California
Department of Fish and Game
Project W46R-2
Game Range Restoration

CF&RES
B. O. Pearson
R. L. Hubbard
November 20, 1953

MONTHLY PROGRESS REPORT

October 20 to November 20, 1953

1. Chemical spray work

   a. Set up 65 spray and check plots for winter and spring treatment.
   b. Applied 13 spray treatments as follows:

Area	Chemical	Lbs./Acre	Date of Applic.	Veget. Type
Casuse	CMU	0.5	11-12-53	Cheatgrass-mustard
"	"	1.5	"	"
"	"	3.0	"	"
"	"	10.0	"	"
"	IPC Cl	6.0	"	"
"	Dalapon	4.0	"	"
"	"	2.0	"	"
"	TCA	10.0	"	"
Flukey	CMU	10.0	11-13-53	Annual wds.-per.gr.
"	IPC Cl	6.0	"	"
"	Dalapon	6.0	"	"
"	"	4.0	"	"
"	TCA	10.0	"	"

2. Obtained two series of soil moisture percent for each Colman soil moisture meter at Flukey Spring, plus soil moisture percent in an intermediate competition type.

3. Hand plantings at Flukey Spring in fenced exclosure:

   a. Planted four rows (25 replications per row) of two strains of bitterbrush collected in Idaho.

   b. Planted 1080 seed spots containing 5 seeds per spot with each variation of planting technique replicated 20 times on a clear cultivated area as follows:

Species	Type	Treatment	Rodent proof	Depth range in inches
Bitterbrush	Seed	Tetramine	Yes	.5, 1.0, 1.5, 2.0, 2.5, 3.0
"	"	"	No	.5, 1.0, 1.5, 2.0, 2.5, 3.0
"	"	None	Yes	.5, 1.0, 1.5, 2.0, 2.5, 3.0
"	"	None	No	.5, 1.0, 1.5, 2.0, 2.5, 3.0
"	Fruit	Tetramine	Yes	.5, 1.0, 1.5
"	"	"	No	.5, 1.0, 1.5
"	"	None	Yes	.5, 1.0, 1.5
"	"	"	No	.5, 1.0, 1.5
Ceanothus cuneatus	Seed	Tetramine	Yes	.25, .5, 1.0
"	"	"	No	.25, .5, 1.0
"	"	None	Yes	.25, .5, 1.0
"	"	"	No	.25, .5, 1.0

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Squawapple	Seed	None	Yes	.5, 1.0, 1.5
"	"	"	No	.5, 1.0, 1.5

c. Replicated bitterbrush seed and Ceanothus cuneatus seed spots plantings under full competition.

4. Plantings of bitterbrush seed by mechanical means at the rate of 4 lbs. per acre (seed was either weighed or sampled from alternate drill spots for control of actual amount of seed planted), as follows:

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CF&RES
R. L. Hubbard
December 2, 1953

MONTHLY PROGRESS REPORT

November, 1953

November 2 (Monday) - Tagged bitterbrush seedlings in dull plots at Flukey Spring with stamped metal tags.

November 3 (Tuesday) - Took soil samples for soil moisture percent determination. Constructed a planting frame.

November 4 (Wednesday) - Laid out and set stakes for dome plantings at Flukey Spring.

November 5 (Thursday) - Stenciled plot markers at Flukey Spring tagging seedlings with metal tags. Drilled plots at Flukey Spring with tetramine treated bitterbrush seed.

November 6 (Friday) - Drilled plots at Flukey Spring and Casuse Mt. with tetramine treated bitterbrush seed.

November 9 (Monday) - Planted bitterbrush seed in dome plot on clear cultivated area at Flukey Spring.

November 10 (Tuesday) - Planted bitterbrush seed in dome plots on undisturbed area at Flukey Spring.

November 12 (Thursday) - Moved tractor and spray rig to Casuse Mt. and sprayed plots there.

November 13 (Friday) - Continued planting bitterbrush seed in undisturbed plots at Flukey Spring. Sprayed plots at Flukey. Laid out more dome plots at Flukey.

November 16 (Monday) - Planted Ceanothus cuneatus seed in dome plots on clear cultivated area at Flukey.

November 17 (Tuesday) - Planted bitterbrush fruit and peraphyllum seed in dome plots on clear cultivated area at Flukey Spring.

November 18 (Wednesday) - Planted Ceanothus cuneatus seed in undisturbed dome plots. Calculated totals for bitterbrush seedling height and diameter.

November 19 (Thursday) - Loaded up gear for Doyle plantings. Worked on calculations in p.m.

November 20 (Friday) - Trip to Doyle.

to RLH ✓
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November 21 (Saturday) - Planted bitterbrush and Ceanothus cuneatus seed in clear cultivated dome plots at Doyle. Nelson Kverno of the U. S. Fish and Wildlife Service in Denver showed up in the evening.

November 22 (Sunday) - Planted bitterbrush seed in undisturbed dome plot at Doyle.

November 23 (Monday) - Planted Ceanothus cuneatus seed in undisturbed dome plot at Doyle. Drilled bitterbrush plots.

November 24 (Tuesday) - Staked down cones. Worked on weather station. Installed seed germination packets. Set plot stakes.

November 25 (Wednesday) - Stenciled plot stakes. Cleaned up area. Collected soil sample. Went back to Modoc.

November 27 (Friday) - Took pictures at Flukey. Planted Ceanothus cuneatus and Peraphyllum seed and bitterbrush fruit in undisturbed dome plots at Flukey. Staked down cones.

November 28 (Saturday) - Put oil in our four rain gages. Worked on weather station. Took pictures at Casuse, Flukey, and Mears.

November 29 (Sunday) - Packed up data.

November 30 (Monday) - Met with Trev Wright and Russ Bushey (Fish and Game) and Don Babbitt (Forest Service) to review procedure of obtaining site factor data. Collected soil sample. Finished staking plots. Left for Berkeley.

Summary

1. Planted seed spots in clear cultivated and undisturbed areas at Flukey Spring with: untreated seed of bitterbrush, Ceanothus cuneatus, and Peraphyllum; tretramine treated seed of bitterbrush and Ceanothus cuneatus; treated and untreated bitterbrush fruit. Half of these seed spots were covered with wire mesh domes to exclude rodents. The spots were planted at various depths to determine optimum planting depth.

2. Replicated #1, but excluding Peraphyllum and bitterbrush fruit, at Doyle.

3. Drilled plots at Flukey Spring and Doyle with untreated and tetramine treated bitterbrush seed.

4. Began collecting soil samples for soil moisture percent determination. This information will be correlated with our Colman soil moisture unit data.

5. Completed fall spraying operation.

6. Got site factor stations at Flukey Spring and Doyle in full operation.

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Project W46R-2

CF&RES
B. O. Pearson
December 21, 1953

MONTHLY PROGRESS REPORT

December, 1953

Accomplishments:

1. The continuation of a second series of hand plantings was carried on at all experimental plot areas. Three hundred and sixty additional seed spots were made at Flukey Spring, bringing the total seed spots to 2720 and completing the planting at Flukey Spring. Forteen hundred and forty seed spots were made at Doyle, which also completed the planned seed spot trials. Twelve hundred seed spots were made at Wells Meadow (one series of Ceanothus cuneatus plantings in competition is still to be made).

2. Thirteen seeding plots were made on the Doyle burn plot. Plots were either drilled or broadcast with treated and untreated bitterbrush seed.

3. The weather stations were rechecked for accuracy and a weather station installed at Wells Meadow.

4. Forty germination packets of bitterbrush were placed in each of the three experimental exclosures.

5. The remaining seed on hand was returned to Berkeley and placed in cold storage.

6. Root examinations of bitterbrush seedlings were made on plots having different levels of competition.

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11/20/53

BITTERBRUSH SEED PLANTINGS

Plot No.	Location	Site Preparation	Planting method	Seed treatment	Planting depth, in.	Plot size in ft.
1 A 2	Casuse	Ploughed and packed 6/53	Drilled	None	1½	30 x 100
2 A 2	"	" " " "	"	"	1½	30 x 100
3 A 1	"	Chem. spray plots 3A through 3M sprayed 6/53	"	"	1 - 1½	10 x 520
3 A 2	"	As 3 A 1	"	Tetramine	1 - 1½	10 x 520
3 B 1	"	.5 lb. CMU sprayed after planting	"	None	1 - 1½	10 x 100
3 B 2	"	1.5 lb. CMU sprayed after planting	"	"	1 - 1½	10 x 100
3 B 3	"	3. lb. CMU sprayed after planting	"	"	1 - 1½	10 x 100
4 A 1	"	PCP spray 6/53, burned 7/53	"	"	1 - 1½	10 x 208
4 A 2	"	As above	"	Tetramine	1 - 1½	10 x 208
4 A 3	"	As above	Broadcast	"	1 —	20 x 208
4 A 4	"	As above	"	None	—	20 x 208
4 B 1	"	PCP spray 6/53, burned 10/53	Drilled	"	1 - 1½	10 x 208
4 B 2	"	As above	"	Tetramine	1 - 1½	10 x 208
4 B 3	"	As above	Broadcast	"	——	20 x 208
4 B 4	"	As above	"	None	——	20 x 208
4 C 1	"	Burned 7/53	Drilled	"	1 - 1½	10 x 208
4 C 2	"	As above	"	Tetramine	1 - 1½	10 x 208
4 C 3	"	As above	Broadcast	"	1—	20 x 208
4 C 4	"	As above	"	None	—	20 x 208
4 D 1	"	Burned 10/53	Drilled	"	1 - 1½	10 x 208
4 D 2	"	As above	"	Tetramine	1 - 1½	10 x 208
4 D 3	"	As above	Broadcast	"	—	20 x 208
4 D 4	"	As above	"	None	—	20 x 208
5 A 1	Flukey	Ploughed 10/52	Drilled	"	1½	10 x 100
5 A 2	"	" "	"	Tetramine	1½	10 x 100
5 B 1	"	Ploughed 10/52, repeated 10/53	"	None	1½	10 x 100
5 B 2	"	Ploughed 10/52, repeated 10/53	"	Tetramine	1½	10 x 100
11 F 1	"	None	"	None	1 - 1½	10 x 100
11 F 2	"	None	"	Tetramine	1 - 1½	10 x 100
12 G 1	"	Ploughed 10/52, packed 6/53	"	None	1	10 x 228
14 A 1	"	PCP sprayed 6/53, burned 7/53, area poisoned with 1080 10/53	"	Tetramine None	1 1½	10 x 228 10 x 208

BITTERBRUSH SEED PLANTINGS (Cont.)

Plot No.	Location	Site Preparation	Planting method	Seed treatment	Planting depth, in.	Plot size in ft.
14 A 2	Klukey	As above	Broadcast	None		20 x 208
14 B 1	"	PCP sprayed 6/53, burned 10/53; area poisoned with 1080 10/53	Drilled	"	1½	10 x 208
14 C 1	"	Burned 7/53, poisoned 1080 10/53	"	"	1½	10 x 208
14 B 2	"	As 14 B 1	Broadcast	"	---	20 x 208
14 C 2	"	As 14 C 1	"	"	---	20 x 208
14 D 1	"	Burned 10/53, poisoned 1080 10/53	Drilled	"	1½	10 x 208
14 D 2	"	Burned 10/53, poisoned 1080 10/53	Broadcast	"	---	20 x 208
14 F 1	"	Dixie drag after seeding 10/53, area poisoned with 1080 10/53 before seeding	"	"	---	12 x 208
14 F 2	"	Dixie drag before drilling, poisoned as above	Drilled	"	1½	10 x 208
14 F 3	"	Dixie drag before broadcast, poisoned as above	Broadcast	"	---	12 x 208
15 A 1	"	(Mears) Chem. spray plots 15 A through E sprayed 6/53	Drilled	"	1½	10 x 200
16 A 1	"	(Mears) PCP spray 6/53	"	"	1½	10 x 208
16 B 1	"	(Mears) PCP spray 6/53	"	"	1½	10 x 208
16 C 1	"	(Mears) None	"	"	1½	10 x 208
16 D 1	"	(Mears) None	"	"	1½	10 x 208