MINUTES OF RANGE RESTORATION PROJECT MEETING

On February 21, 1956, a meeting was held in the staff headquarters in order to discuss progress and future plans for the game range restoration segment of project W-51R. It was attended by fifteen persons representing the project, branch administration, Regions I, II and IV, and the food habits section of the laboratory.

In explaining the current method of study, Hormay pointed out that bitterbrush was chosen for emphasis because the solution of problems attendant to its establishment would be applicable to other browse species. Bitterbrush had been indicated previously as one of the most important winter deer forages east of the Sierra.

Success in the establishment of bitterbrush from seed has been obtained from both fall and spring plantings, in the Flukey Springs and Doyle areas. Planting techniques are still crude and in need of refinement but it has been learned that competing vegetation must be removed prior to planting. The goal is to be able to prepare the site and get the seed into the ground at a cost of 12 to 16 dollars per acre. Thus, from an economic basis, it appears that seeding bitterbrush on east side winter ranges is not the correct answer.

The study does anticipate and is working on a study plan covering an investigation of the cyclical nature of bitterbrush stand establishment. This is a basic ecological study relating the ages of the stands through sample ring counts, to the weather at the time of establishment. It is also possible that rodent and/or rabbit cycles may be a factor.

The general consensus seemed to be that bitterbrush remains the most important forage species during late fall and early winter, except during mild winters when green grass is available. The prime requirement is a forage species (preferably several species) which will provide a high level of nutrition during the late winter. All presently available browse are at a low level of nutrition during even the mild winters.

Bissell stated that straight diets, regardless of species, result in unfavorable conditions for deer. He went on to theorize that quantity and palatability may be more important than the quality of the species. The palatability factor was stressed. On east-side ranges the quantity forage is sagebrush which is low in palatability. However, Leach pointed out that in California, as Hjersman indicated for the balance of the Great Basin states, the deer shift from bitterbrush to sagebrush as the main browse component of the diet after the first one or two months of winter.

Hormay mentioned the possibility of the introduction of other browse forage species. He stressed the ecological limitations of the present three study areas in relation to the suggested introductions. He pointed out there are at least four ecological sites on most winter ranges, on which the following species commonly occur:
Upper marginal limits of winter range

1. Amelanchier alnifolia  Serviceberry
2. Ceanothus velutinus  Snow brush
3. Ceanothus integerrimus  Sweet birch
4. Cercocarpus ledifolius and  S. betuloides  Mountain mahoganies

Middle elevations

1. *Purshia tridentata  Bitterbrush
2. *Artemisia tridentata  Sagebrush
3. *Cercocarpus ledifolius  Mountain mahogany
4. *Prunus ilicifolia  Hollyleaf cherry
5. *Quercus spp.  Oaks
6. *Ceanothus cuneatus and  C. leucodermis  Buckbrush and chaparral whitethorn

Lower elevations

1. *Artemisia tridentata  Sagebrush
2. *Chrysothamnus spp.  Rabbitbrush
3. *Cowania stansburiana  Cliffrose
4. *Grayia spinosa  Hopsage
5. *Purshia glandulosa  Bitterbrush
6. *Rhamnus crocea (Xeric form)  Redberry
7. *Ceanothus greggii  Desert ceanothus

Lower Xeric elevations

1. *Eurytia lanata  Winter fat
2. *Atriplex canescens  Four-winged saltbush

Plants marked with an asterisk were suggested by the group as being worthy of consideration.

Hormay expressed surprise and pleasure at the length of the list but pointed out the limitations of the study both as to time and expenditure. Dasmann asked that priorities be assigned to a lesser number and the following list was derived:

1. Bitterbrush
2. Four-wing saltbush
3. Cliffrose
4. Redberry - (a xeric form)
5. Sagebrush species

Hormay stated the range restoration project would start preliminary work with these forage species in the early future.

Henry A. Hjersman
Game Biologist

HAH:gw
2/29/56 - 30 copies
STATE  California  
PROJECT  W51RL  
DATE  April 2, 1956  

QUARTERLY PROGRESS REPORT  
SURVEYS AND INVESTIGATIONS  
as required by  

FEDERAL AID IN WILDLIFE RESTORATION ACT  

1. Title of Project: Big Game Investigations (Game Range Restoration Study Segment).  

2. Supervisors: Ben Glading, Chief; Harvey Russo, Assistant Chief, Acting, Game Management Branch, California Department of Fish and Game.  

3. Project Leader: William P. Dasmann; Henry Hjersman, Assistant Project Leader, California Department of Fish and Game.  


5. Cooperating Agency: California Forest and Range Experiment Station  


   This report is not for publication  

Purpose  

The primary objective of this project is to develop cultural methods of re-establishing and extending native or introduced browse species suitable for forage or cover on deteriorated deer ranges in California. The project was initiated 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 herbage and hinders the movements of deer. Under these conditions erect, upstanding shrubs become premium forage plants for deer. Bitterbrush (Purshia tridentata) is the most important game browse plant in the region and is being given special attention in these studies.  

General Accomplishments and Findings During the Period  

1. Spring field work got under way the last week in February. Work at Wells Meadow and Doyle Experimental areas included plantings of 24 strains of bitterbrush, depth of planting tests, and tests of effects of
thiourea on the germination and establishment of bitterbrush. In addition a
1-acre pilot seeding of bitterbrush and smaller preliminary seedings of fourwing
saltbush (Atriplex canescens) were made on the Doyle area. Winter conditions
precluded work on the Flukey Spring and Casuse Mountain areas during the quarter.

2. Project personnel attended and participated in several meetings
during the period. A project conference was held at Sacramento with California
Fish and Game Department personnel to review work on deer nutrition and browse
species preferences. At this meeting several desirable browse species were
selected for inclusion in the project program as opportunity and resources
permit. The species selected were Atriplex canescens and A. confertifolio,
Cowania stansburiana, Rhamnus crocea, Artemisia tridentata, and Erotia lanata.

The Ninth Annual Convention of the American Society of Range Management
held in Denver on January 24 to 27 was attended by E. J. Woolfolk, A. L. Hormay,
and E. C. Nord. Nord reported on progress in development of equipment for
browse seeding. R. L. Hubbard attended the January meeting of the California
Section of the Wildlife Society at Davis.

3. Laboratory tests with fourwing saltbush and cliffrose seed resulted
in moderate germination in 15 days without seed treatment. There is a strong
indicating that considerable variability exists in the seed of fourwing saltbush
from different sites.

4. Data analyses and publication writing continued during the period.
One article entitled "The effect of plant competition on growth and survival
of bitterbrush seedlings" was completed and submitted for publication.

The present report deals mainly with seed germination, seedling emergence,
and early plant development in several strains of bitterbrush.

Personnel

William B. Larson, a junior in the University of California School of
Forestry, assisted with seed germination studies and compilation of research
data on a part time basis. Milton J. Funk assisted part time with project
activities at Bishop.

Bitterbrush Strain Study

In September 1955 a study was started to determine the existence of
strains in Purshia tridentata and Purshia glandulosa. The study aims to
develop criteria for differentiating between strains and determining the
suitability of the strains to particular sites. Greenhouse, laboratory, and
field planting phases have been undertaken to date.

Greenhouse Phase:--Seed of Purshia tridentata and Purshia glandulosa from 30
different sources was planted under uniform conditions in a plot in a
greenhouse in Berkeley. Seeds from each source were planted in 5 randomly
located spots. Five seeds from a given seed source were planted in each
spot. The seeds were spaced about 3 inches apart.
The seedlings in this experiment are now 1 to 3 inches tall. Out of 960 seeds planted, 70 percent emergence was obtained. All but one or two seed sources are well represented with seedlings. Even at this early stage distinct growth and morphological differences are showing up between *Purshia tridentata* and *Purshia glandulosa* and in forms of *Purshia tridentata* collected in California, Idaho, Utah, and Washington.

In *P. glandulosa* the leaves are finely and deeply dissected and the leaf margins are rolled under. In *P. tridentata* the leaf segments are few, sinuses shallow, and the leaf margins not rolled under. *Purshia glandulosa* seedlings emerged and grew more slowly at early stages than *P. tridentata*.

In *P. tridentata* seedlings from Ephriam Canyon seed, all leaves are distinctly bright green in color. Pubescence on the upper surfaces is lacking. Seedlings from other seed sources have hairy leaves.

Seedlings from seed collected at Hermiston, Washington and Mono County, California grew more rapidly in early stages than those from other sources. Seedlings from Boise, Idaho seed can be differentiated from all others by large leaves and large stipules.

Constant Temperature Phase:—Seedlings from 15 different seed sources are being grown under three different constant temperatures—36°F, 50°F, and 77°F—in the laboratory. Here too the plantings are replicated and randomized. Most of the 15 seedling groups are exhibiting distinctive growth behavior.

Damping off was very high in one seed source at 77°F, but was not evident at 50°F. One seed lot of *Purshia tridentata* from Mono County, California and one of *P. glandulosa* from San Bernardino County, California showed more rapid elongation at 36°F than other seed sources.

In one lot of *P. glandulosa* seed from San Bernardino County, California no germination has occurred to date at 36°F, but about 20 percent germination occurred at 77°F. Another lot from the same County gave 96 percent germination at 36°F. While being stratified at 36°F, one lot of seed from Mono County produced roots averaging 15 cms long. Under these same conditions seed lots from some other localities did not produce any root growth and others produced roots averaging only 6 cms long.

In general, *P. glandulosa* seedling have been slower to emerge throughout the temperature range studied than have *P. tridentata* seedlings. Also, *P. glandulosa* seedlings have developed more root hairs than *P. tridentata* seedlings.

Field Phase:—Bitterbrush seeds from 24 different sources were planted at the Wells Meadow and Doyle Experimental Areas in March. No seedlings have
yet appeared from these plantings because of the short lapse of time since planting. Plantings of the same seed lots are planned for Flukey Spring in early April. The utility of the various strains that are showing up in the greenhouse and laboratory will become evident largely in these field plantings.

SUBMITTED BY:
E. J. Woolfolk, Segment Leader

By

Eamor C. Nord

APPROVED BY:
California Department of Fish and Game

By
QUARTERLY PROGRESS REPORT

SURVEYS AND INVESTIGATIONS

as required by

FEDERAL AID IN WILDLIFE RESTORATION ACT

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3. Project Leader: William P. Dasmann; Henry Hjersman, Assistant Project Leader, California Department of Fish and Game.


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

6. Summary report of progress during the quarter April 1 to June 30, 1956.

This report is not for publication

Purpose

The primary objective of this project is to develop cultural methods of re-establishing and extending native or introduced browse species suitable for forage or cover on deteriorated deer ranges in California. The project was initiated 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 herbage and hinders the movements of deer. Under these conditions, erect, upstanding shrubs become premium forage plants for deer. Bitterbrush (Purshia tridentata) is the most important game browse plant in the region and is being given special attention in these studies.

General Accomplishments and Findings During the Period

1. Spring seedings were completed during the period at all experimental areas. These plantings were designed to provide information on depth-of-planting, effect of thiourea on seedling germination and survival, existence and utility of strains in bitterbrush and tests of other species.
2. Six pilot seedlings each containing about one acre, were made on prepared, cultivated seedbeds at the following locations: One at Doyle, two at Casuse Mountain and three at Flukey Spring. Fair emergence was obtained at the Flukey Spring area. Comparable fall seedings at this site as well as both fall and spring plantings at the other locations have not been as satisfactory. Failure to obtain good stands from fall plantings is partly attributed to soil crusting which developed this spring.

3. Seed germination studies with hammermilled fourwing saltbush (Atriplex canescens) indicate that total germination as well as rate, are affected by the size of the seed. The smaller sized seed gave higher and more rapid germination than the larger sized seeds.

4. Initial results from exploratory field plantings made at Doyle and Flukey Spring with fourwing saltbush this spring are encouraging. More than 10 percent of the seeds planted have produced seedlings which have grown rapidly, some plants making more than 1 foot growth so far this season.

5. Insects damaged many of the bitterbrush seedlings this spring. Most of the damage was caused by cutworms, but wire worms, leaf miners, termites and other unidentified insects also damaged seedlings or prevented the germinating seeds from emerging. Most experimental seedings were treated with dieldrin dust to minimize insect attacks.

6. An exploratory soils investigation was made by the Soils-Vegetation Survey division of the California Forest and Range Experiment Station on a number of experimental areas on the eastside. It was observed that bitterbrush seldom occupies soils having a pH of 7.0. None was found where the soil pH was 7.5 or above or where there was any appreciable showing of free lime.

The remainder of this report deals mainly with damage to bitterbrush seedlings by insects and seedling emergence from depth-of-planting studies.

**Personnel**

Bennett O. Pearson who has been with the project since October 1952 was transferred to the Okanogan National Forest at Twisp, Washington on July 1. W. B. Larson, J. E. Whitacre and John Van Zander, all temporarily employed University of California Forest School students left the project for summer jobs.

**Damage to Bitterbrush Seedlings by Insect Larvae**

Damage and destruction of bitterbrush seedlings caused by insects and their larvae has been observed in experimental bitterbrush plantings made during the last 4 years. Most of the damage occurred during or soon after the seedlings emerged and before the plants developed woody tissues. Above soil parts including cotyledons, leaves and stems, as well as the root systems, of the small seedlings were chewed or clipped off by the insects. Observations of seedling mortality from fall 1955 plantings indicate that the heaviest losses from all causes occurred at Doyle and the lowest at Flukey Spring. The Wells Meadow area was intermediate. From spring 1956 plantings the losses were greatest at Wells Meadow and lowest at Flukey Spring.
Seedling mortality to June 15 from all causes was 98 percent from fall seeding at Doyle compared to 6 percent at Fluekey Spring and 71 percent at Wells Meadow. Sixty-five to 90 percent of this mortality was caused by insects. Losses on spring seeded areas were higher at Wells Meadow and Fluekey Spring and considerably lower at Doyle.

Evidence was also found that insect damage to the germinating seed occurs before emergence. The percentage of germinated seeds affected and the extent to which this may have reduced seedling emergence were not determined.

Specimens of cutworms collected in the Doyle area have been identified as the variegated cutworm (*Lycophotia margaritosa*), the most important and commonest species throughout the west. It lives in the soil and feeds at night on roots or above ground plant parts.

Apparently cutworm and wire worm damage to seedlings was much more prevalent this spring than in previous years. This was substantiated by reports from local farmers and gardeners. This may have been due to the abundance and distribution of precipitation last fall and this spring.

**Bitterbrush Depth-of-Planting**

Depth at which bitterbrush seed is planted is one of the most important factors affecting seedling emergence. Experience through four planting seasons on three sites has indicated that best results are obtained by planting at 1/2- to 1-inch depths. Very little or no seedling development or emergence has occurred from seed placed on the soil surface or at depths greater than 2 1/2 inches.

Results from the last four planting seasons are shown in Table 1. The plantings were all on cultivated land and the seeds were hand planted at half-inch depth intervals from 0- to 4-inches and protected from rodents and grazing animals. Spring planted seeds were soaked in a 3 percent solution of thiourea for 4 minutes then air dried before planting. No seed treatment was used on fall plantings.

Seedling emergence from spring plantings was much higher this year than previous years. Emergence from 1955 fall plantings was perhaps down a little. One inch appeared to be about the maximum for fall planting, except in 1954 at Wells Meadow, and 2 inches was the maximum depth for spring seeding.

This year's records tend to support previous contentions that thiourea treated bitterbrush seed probably responds differently and requires more moisture for germination and development than untreated, naturally stratified seed. Emergence from thiourea treated seed typically begins somewhat later and extends over a much longer period compared to untreated fall planted seed. This year after each soaking rain, a few more seedlings emerged from the thiourea treated seed. The high emergence from this spring's plantings was obtained under more favorable moisture conditions than in the preceding year. Precipitation this year was high and well distributed during the early seedling development stage. This undoubtedly accounts for the high emergence this year compared to last year when less rainfall was received.
Table 1.—Bitterbrush seedling emergence from seed planted at specified depths

<table>
<thead>
<tr>
<th>Experimental area</th>
<th>Time of planting</th>
<th>0</th>
<th>1/2</th>
<th>1</th>
<th>1 1/2</th>
<th>2</th>
<th>2 1/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flukey Spring</td>
<td>Fall 1955</td>
<td>2</td>
<td>52</td>
<td>16</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1954</td>
<td>0</td>
<td>44</td>
<td>38</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Spring 1956</td>
<td>0</td>
<td>29</td>
<td>47</td>
<td>32</td>
<td>11</td>
<td>T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1955</td>
<td>0</td>
<td>16</td>
<td>17</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Doyle</td>
<td>Fall 1955</td>
<td>0</td>
<td>38</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1954</td>
<td>0</td>
<td>44</td>
<td>57</td>
<td>16</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Spring 1956</td>
<td>0</td>
<td>30</td>
<td>33</td>
<td>20</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1955</td>
<td>0</td>
<td>8</td>
<td>16</td>
<td>5</td>
<td>T</td>
</tr>
<tr>
<td>Wells Meadow</td>
<td>Fall 1955</td>
<td>1</td>
<td>48</td>
<td>36</td>
<td>14</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td></td>
<td>1954</td>
<td>0</td>
<td>64</td>
<td>68</td>
<td>62</td>
<td>36</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Spring 1956</td>
<td>1</td>
<td>40</td>
<td>39</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1955</td>
<td>1</td>
<td>48</td>
<td>36</td>
<td>14</td>
<td>T</td>
</tr>
</tbody>
</table>

1/ Less than 0.5 percent.

Each test based on 500 seed.

SUBMITTED BY:  
E. J. Woolfolk, Segment Leader

APPROVED BY:  
California Department of Fish and Game

By [Signature]  
Samor C. Nord
General Accomplishments and Findings During the Period

1. Field work was initiated on a comprehensive study of bitterbrush ecology in California. This study is expected to yield more complete information on site requirements, reproductive characteristics, age of existing stands, weather conditions favoring natural establishment, successional stage on various sites, and other information needed for adequate restoration and management of bitterbrush stands.

2. The following articles dealing with game-browse restoration have been completed and published during the quarter:

   "Quick testing of bitterbrush seed viability" by Eamor C. Nord in the July issue of the Journal of Range Management.

   "An outrigger type deer fence" by James A. Blaisdell and R. L. Hubbard, California Forest & Range Experiment Station Research Note No. 108.

   "The effects of plant competition upon the growth and survival of bitterbrush seedlings" by R. L. Hubbard in CF&RES Research Note No. 109.

   "Effect of depth of planting on the emergence of bitterbrush seedlings" by R. L. Hubbard in CF&RES Research Note No. 113.

   "Bitterbrush seedlings destroyed by cutworms and wireworms" by R. L. Hubbard in CF&RES Research Note No. 114.

3. Most of the project activities and personnel were moved to the Susanville Research Center during September.

4. Rabbits continued to damage or destroy many of the young bitterbrush seedlings in the Doyle area. Practically all seedling plants in pilot seeding trials at this location had been clipped by early September. Approximately 33 percent of the plants had been killed, 45 percent of the plants had been heavily clipped and the remainder had been...
clipped to a lesser degree. Practically none of the plants had escaped clipping by rabbits at this time.

The remainder of this report deals mainly with results obtained from greenhouse and field plantings with several strains (sources) of bitterbrush.

Bitterbrush strains

Results from greenhouse plantings:

Studies which were started in September 1955 to determine the existence of strains in bitterbrush have been continued with additional observations and measurements on both greenhouse and field plantings. Preliminary results obtained from germination tests in the laboratory as well as observations on greenhouse plantings were reported in the April 1955 Quarterly Progress Report. At that time certain morphological and growth differences were apparent.

The laboratory studies showed *Purshia tridentata* generally gave a more rapid and higher percentage of germination than was obtained with *Purshia glandulosa* seeds. The average germination of *P. tridentata* from 25 seed sources was 84.5 percent whereas it was 59.5 percent for *P. glandulosa*. The average time for seedling emergence in the greenhouse was about 5 days less for *P. tridentata* than for *P. glandulosa*. There was a strong tendency for the *P. glandulosa* seedlings to retain the seed coats around the cotyledons for 2 to 5 days after emergence. In contrast, the seed coats of *P. tridentata* were shed at or soon after emergence. The retention of the seed coat on the cotyledons is considered to indicate a form of dormancy which may be associated with the initial radicle elongation. Both the extended period of germination and radicle growth are considered to be inherently genetic characteristics which may possibly be a result of selective climatic factors.

More recent work suggests that growth patterns may be associated with the species of bitterbrush and the general location of the seed source. Seedlings from different seed sources grew at significantly different rates in the greenhouse during the first 165 days. These differences were most apparent between the two species and in *P. tridentata* between the different locations from which seed was obtained.

*Purshia tridentata* seedlings produced longer main stems than did *P. glandulosa* seedlings. The average height of the main seedling stems for *P. tridentata* from 25 seed sources was 15.7 cm. and for *P. glandulosa* from 4 sources it was 7.8 cm. In no instance did the average stem height of any of the *P. glandulosa* seed sources attain that of the *P. tridentata* seedlings.

Optimum seeding growth in southern sites of *P. tridentata* (generally south of Lake Tahoe), was obtained from seed collected between 6,500 and 8,000 feet elevation. For the northerly areas best seeding growth was obtained from seeds collected below 4,600 feet.
Growth of plants from seeds obtained in the Rocky Mountain area was generally lower than in those from seed obtained in the Sierra-Cascade mountain ranges. Only seeds obtained near Ephriam canyon, Utah and Boise, Idaho made growth comparable with collections obtained further west. Least growth was obtained from seed collected in Fremont County, Idaho.

Field plantings:

Results obtained from field plantings of 24 different seed sources at three locations shown in table 1 indicate that seed source probably is an important factor affecting emergence and early survival of bitterbrush plants. Only a few of the seed sources used in these tests gave satisfactory germination and early season survival. One collection of P. glandulosa seed obtained near Desert Springs in San Bernardino County gave better emergence at any of the field locations than it did in the greenhouse.

Three seed sources gave satisfactory emergence (24 percent or above) at Wells Meadow, 12 at Doyle and 15 at Flukey Spring.

Adaptability of these various seed sources to various situations has not yet been finally determined. It is rather apparent, however, that careful selection of seed source may be increasingly important with the drier sites. Thus, at the more southerly or drier situations attempts should be made to plant seeds obtained from bitterbrush stands reasonably similar to the conditions present on the planting site.

Table 1. --- Emergence and early season survival of bitterbrush seedlings from various seed sources.

<table>
<thead>
<tr>
<th>Strain : Game-</th>
<th>test : browse : Collection site, date,</th>
<th>emergence : seedlings : General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed data : Total : survival : of emerged : (50 seed) : (to June 1) : rating</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percent</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wells Meadow</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>GB-111</td>
</tr>
<tr>
<td>17</td>
<td>GB-91</td>
</tr>
<tr>
<td>Seed data</td>
<td>Field results</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Strain : Game-test</td>
<td>Total survival of emerged seedlings : General rating</td>
</tr>
<tr>
<td>test : browse : Collection site, date, number : number : and collector</td>
<td></td>
</tr>
<tr>
<td>(50 seed) (to June 1)</td>
<td></td>
</tr>
<tr>
<td>1. Wells Meadow - Continued</td>
<td></td>
</tr>
<tr>
<td>18 GB-109 North of Sherman Summit at elev. 7,000 feet on Hwy. 395, Mono Co., Cal.</td>
<td>28</td>
</tr>
<tr>
<td>2. Doyle</td>
<td></td>
</tr>
<tr>
<td>2 GB-20 Near Janesville on Hwy. 395, Lassen Co., Calif. Elevation 4,400 feet.</td>
<td>38</td>
</tr>
<tr>
<td>3 GB-42 Near Janesville on Hwy. 395, Lassen Co., Calif. Elevation 4,500 feet.</td>
<td>36</td>
</tr>
<tr>
<td>12 GB-97A McMurray Meadows, SW of Big Pine, Inyo Co., Calif. Elev. 5,000 feet</td>
<td>32</td>
</tr>
<tr>
<td>17 GB-91 See above</td>
<td>28</td>
</tr>
<tr>
<td>21 GB-111 See above</td>
<td>32</td>
</tr>
<tr>
<td>35 GB-115 East of Hwy. 395 and Conway Summit, Mono Co., Calif. Elev. 8,500 to 8,700 feet</td>
<td>28</td>
</tr>
<tr>
<td>3. Flukey Springs</td>
<td></td>
</tr>
<tr>
<td>2 GB-20 See above for Doyle</td>
<td>42</td>
</tr>
<tr>
<td>3 GB-42 See above for Doyle</td>
<td>34</td>
</tr>
<tr>
<td>6 GB-46 Boise, Idaho, 3,300 feet elevation</td>
<td></td>
</tr>
<tr>
<td>8 GB-71 Grandview Area (Metolius) Sisters' Dist., Deschutes, NF Oregon. Elev. 2,500 feet</td>
<td>28</td>
</tr>
<tr>
<td>Strain</td>
<td>Test</td>
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<tr>
<td>GB-97A</td>
<td>See above for Doyle</td>
</tr>
<tr>
<td>GB-109</td>
<td>See above for Walls Meadow</td>
</tr>
<tr>
<td>GB-112</td>
<td>South of Leevining on Hwy. 395, Mono Co., Calif. Elev. 6,850 feet</td>
</tr>
<tr>
<td></td>
<td>Virginia Lake Road, Mono Cty., Calif. Elev. 9,000 feet</td>
</tr>
</tbody>
</table>

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**SUBMITTED BY:**
E. J. Woolfolk, Segment Leader

**APPROVED BY:**
California Department of Fish and Game

**By**

[Signature]

By

[Signature]