COO-2743-1

REVEGETATION FOLLOWING ARTIFICIAL DISTURBANCE

Progress Report
for Period 1 June 1975-29 February 1976

Leslie Fraley, Jr.

Department of Radiology and Radiation Biology
Colorado State University
Ft. Collins, Colorado 80523

MASTER

1 April 1976

Prepared For

THE U. S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
UNDER CONTRACT NO. E(11-1)-2743

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

fy

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed or represents that its use would not infringe privately owned rights.

CONTENTS

Abstract	1
Introduction	1
Subproject 1. Rocky Flats Reclamation Studies	1
Subproject 2. Radiation Effects on Shortgrass Plains	
Vegetation	6
Effects	6
Recovery patterns	6
Other Work	7
Literature Cited	9

REVEGETATION FOLLOWING ARTIFICIAL DISTURBANCE

L. Fraley, Jr.

Abstract: Areas at Rocky Flats that had previously been reseeded by Rocky Flats personnel were evaluated for seeding success. Only one species in the seed mixture, Agropyron smithii (western wheatgrass) made a significant contribution to the stand. Two other species which made important contributions but were not in the seed mixture were Bromus tectorum (cheatgrass) and B. inermis (smooth brome).

The vegetation receiving chronic exposure to ionizing radiation at the Grasslands Irradiation Study Area appears to be near equilibrium although electromagnet failure prevented irradiation for approximately 3 months during late summer 1975. Secondary succession is continuing in the sectors given a seasonal, short-term exposure in 1969 but at exposures where the dominant species, Bouteloua gracilis (blue grama) was killed there is no indication that any recovery of the B. gracilis is taking place.

In plots that were artificially disturbed by burning, scraping and tilling, recovery patterns in the burned plots most nearly parallel recovery patterns of the areas receiving intermediate damage from exposure to ionizing radiation. For the scraped and tilled plots, recovery patterns most nearly paralleled those receiving heavy damage from exposure to ionizing radiation where all B. gracilis was killed.

INTRODUCTION

On 1 November 1975, a modification of this contract was requested through the Chicago Operations Office transferring the "Effects of Radiation on a Shortgrass Plains Ecosystem" from E(11-1)-1156, Dr. F. W. Whicker, Principal Investigator, to this contract, E(11-1)-2743. Included in this request was a name change to "Revegetation Following Artificial Disturbance." This modification was approved and this progress report includes work on both subprojects.

SUBPROJECT 1. ROCKY FLATS RECLAMATION STUDIES

I was unable to find a qualified and interested graduate student to work on this study during the past year. This, plus difficulty in seedbed preparation (the rocky soil actually damaged the tillage equipment), caused a delay in the initiation of seeding and, to date, no field seeding has been accomplished. Seedbed preparation was attempted in the fall of 1975. Since then, time has been spent investigating possible modifications to seedbed preparation procedures to allow for adequate seedbed preparation without unnecessary damage to the tillage equipment.

In order to investigate the potential for wind soil erosion and possible radionuclide resuspension that might take place during the early part of revegetation, I had two bagnold catchers made (2). These will be used in experiments during the spring and subsequent months. Results of these studies will be correlated with similar studies being conducted at the INEL Site.

In late summer 1972, some reseeding using native species was done on the east side of the plant. This area is south of the east access road coming in to the east portal from Indiana Street and includes an

old gravel pit area as well as some old roadbeds. The seeding was done under the supervision of Chuck Illsley, staff biologist at Rocky Flats. Topsoil was brought in and the area was irrigated for about 2 years after seeding. The seed mixture used is in Table 1.

In order to evaluate the success of the seeding, I established two transects in the larger area in the fall of 1975. One was oriented north-south and was 110 m long. This started approximately 35 m south of the east access road and continued south. The second transect was approximately east-west and was 280 m long. On 25 September 1975, 25 X 25 cm quadrats along each transect were checked for species and an estimate of percent cover and percent bare soil made. A 0.5 m² plot was clipped for standing crop estimates at approximately one of each four quadrat locations (Table 2). From the species lists, frequencies of occurrence and diversity were calculated (Table 3). Diversity was calculated using the equation:

$$D = -1.44 \sum p_i \ln(p_i).$$

Although the data are sketchy, two conclusions are possible. One, only three species were important in the early stages of revegetation; Agropyron smithii (western wheatgrass), Bromus tectorum (cheatgrass) and B. inermis (smooth brome). Also, only one of these, A. Smithii, was seeded. Apparently the other two were brought in with the top soil and/or were dissiminated locally after the top soil was brought in. The second case is very likely for the cheatgrass since this species is widely distributed on the Rocky Flats Site (Weber, 3). This would imply serious limitations from any effort made in seeding on the Rocky Flats Site. Only several years' data can determine the persistence of the above species.

Table 1. Seed mixture used at Rocky Flats in late summer 1972 seeding.*

Content	Percent
Andropogon scoparius (little bluestem)	21
A. gerardi (big bluestem)	18
Agropyron smithii (western wheatgrass)	17
Bouteloua curtipendula (sideoats grama)	10
Other crop	1
Weed	0.4
Inert	33

*Information supplied by Chuck Illsley

Table 2. Selected Parameters for transects 1 and 2 measured on area reseeded at Rocky Flats.

Transect	Standing crop (g/m ²)	Percent cover	Percent bare soil	Diversity
1	170 ± 56	40 ± 26	12 ± 18	1.2
2	133 ± 64	40 ± 23	22 ± 25	2.3

Table 3. Frequencies for all species sampled in Transects 1 and 2.

n = 21 for transect 1 and 57 for transect 2. Quadrat size was 25 X 25 cm².

Species	Frequency	
	Transect 1	Transect 2
<u>Agropyron desertorum</u> (crested wheatgrass)	--	0.053
<u>A. smithii</u> (western wheatgrass)	0.90	0.81
<u>Bouteloua curtipendula</u> (side-oats grama)	--	0.018
<u>B. gracilis</u> (blue grama)	--	0.075
<u>Bromus inermis</u> (smooth brome)	0.33	0.19
<u>Bromus tectorum</u> (cheatgrass)	0.38	0.58
<u>Liatris punctata</u> (dotted gayfeather)	--	0.035
<u>Sitanion hystrix</u> (bottlebrush squirreltail)	--	0.053
<u>Stipa comata</u> (needle and thread)	--	0.018
<u>Yucca glauca</u> (small soapweed)	--	0.018

SUBPROJECT 2. RADIATION EFFECTS ON SHORTGRASS PLAINS VEGETATION

During the summer at approximately 0300 on 24 July 1975, the electromagnet failed and the source dropped. It was necessary to remove the mast and return it to Fort Collins and replace the electromagnet. Considerable time was spent getting a new magnet, fitting it to the lifting mechanism and reinstalling the mast. The source was put back in operation 4 October 1975. The total down time was 72.5 d which occurred during an important part of the growing season. There was some evidence of recovery during this time by Euphorbia glyptosperma (ridgeseed euphorbia) but this was not measurable. Whether or not this will affect the longer trend may take 2 or 3 years to determine.

Effects

Species density data were collected in all sectors during the last 2 weeks of June. From this data, frequency, coefficient of community (CC), and diversity (D) were calculated. Based on CC and D values, there was no detectable change due to radiation effects this past year in the chronically irradiated sectors.

Considering the dominant species, Bouteloua gracilis (blue grama) the data indicate that it has reached a steady state condition with the radiation as determined by cover.

Recovery patterns

Irradiated areas: The 1975 data did not indicate any new trends in recovery patterns. B. gracilis has not germinated in any area where it was completely killed out. In those radiation zones where it was killed back but had some living crowns, recovery as measured by percent cover,

seems to be complete. Other forms of recovery were following general secondary succession patterns but are still in the early stages. Diversity in the irradiation damaged areas has returned to near normal values, but the plant community is not the same as prior to irradiation (See Fraley, 1974, for a more complete description of recovery). Mechanically disturbed areas: Diversity was higher in all plots that were mechanically disturbed but there was no effect of treatment or season of treatment. Percent cover by B. gracilis showed a treatment effect. The burned plots were recovered and had the same cover as the control, regardless of season of treatment. The scraped and rototilled plots had very little B. gracilis cover and averaged about 3% of the control cover. There was no indication that the cover values for the scraped and rototilled plots were different than in 1974.

OTHER WORK

At the present time I am involved in two other areas of research, which includes partial support, plus my normal teaching load at Colorado State University.

I am working with Dr. O. D. Markham of the ERDA Health Services Laboratory, INEL, on several projects and working with several graduate students. The graduate students take course work at CSU following the Radioecology program and do their research at the INEL Site. Currently, there are 4 graduate students and they are supported through a contract with the Idaho Operations Office.

I am on partial support of Contract E(11-1)-1156 (Dr. F. W. Whicker, PI) and am assisting with the development of a Rocky Flats grasslands ecosystem Pu model.

During this past year I was able to attend 3 significant meetings (not supported by this contract). These were the Ecology-Meteorology Workshop held 9-13 June 1975, at the University of Michigan Biological Station; The International Symposium on Transuranium Nuclides in the Environment held 17-21 November 1975, at San Francisco; and the Plutonium Information Conference of the Nevada Applied Ecology Group held 12-13 February 1976.

LITERATURE CITED

1. Fraley, L., Jr. 1975. Radiation effects on shortgrass plains vegetation. pp. 85-91 in F. W. Whicker, Radioecology of Natural Systems in Colorado. Thirteenth annual progress report on U. S. ERDA Contract AT(11-1)-1156. COO-1156-80.
2. Gillette, D. A. and P. A. Goodwin. 1974. Microscale transport of sand-sized soil aggregates eroded by wind. J. Geophysical Research 79(27): 4080-4084.
3. Weber, W. A., G. Kunkel and L. Schultz. 1974. A botanical inventory of the Rocky Flats AEC site. Final Report on Contract AT(11-1)-2371. COO-2371-2.