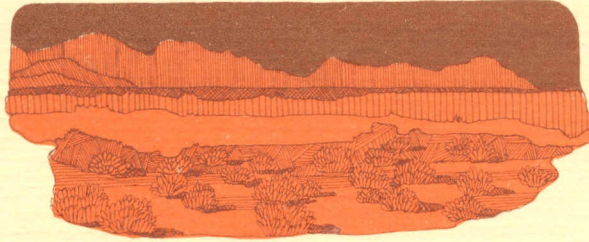


Utah State University · Logan, Utah 84322

*Sust. A.,
✓ file*

Institute for Land Rehabilitation
UMC 52
Phone (801) 752-4100 x7266



College of Natural Resources
Agricultural Experiment Station

N22

July 28, 1978

Mr. Thomas Henry
Assistant Chief, I&RM
Bryce Canyon National Park
Bryce Canyon, Utah 84717

Dear Tom:

Our fall planting (September 11-15, 1978) plan is as follows:

Fairyland Overlook - 35 sagebrush plants, all plants will be surrounded by wire cages (chicken wire, approximately 30 cm high and 15 cm in diameter), one half of the plants with fertilizer (50 lbs./acre N), one half of the plant without fertilizer.

Sunrise Overlook - 30 bitterbrush plants, all caged, one half with fertilizer, one half without fertilizer (as mentioned above); 80 manzanita plants - one half inoculated with native soil, one half not inoculated with native soil, caging and fertilizer treatments as mentioned above.

Farview Overlook - 80 manzanita plants with same treatments as mentioned for manzanita plants as Sunrise.

Rainbow Overlook - 30 juniper plants, all caged, one half with fertilizer, one half without fertilizer.

The cages aren't aesthetically pleasing but they will hopefully prevent rodent and trampling damage during the first year of plant establishment. We would also like to place small signs next to our plantings. The sign would be a dark natural brown with white lettering, and would say "Experimental Plantings Please Stay Off".

During our stay, Jerry and I would like to finish our infiltration readings in the two campgrounds and collect some plant material for propagation studies. Jerry will also be visiting Bryce Canyon during the week of August 7-11 to collect some seeds and plant cuttings.

Sincerely,

Chris Call

Christopher A. Call

CAC/rh

Institute for Land Rehabilitation
UMC 52
Phone (801) 752-4100 x7266



College of Natural Resources
Agricultural Experiment Station

May 9, 1978

Mr. Thomas Henry
Assistant Chief, I & RM
Bryce Canyon National Park
Bryce Canyon, Utah 84717

Dear Tom:

Jerry Barker and I enjoyed our brief stay at Bryce Canyon last month. This is a short one to let you know that we are changing the date of our June studies. We will be going our vegetation and soil infiltration studies June 19-24, rather than the first part of June.

We decided to collect and propagate the following species for outplanting on overlooks:

Pinemat manzanita	(<u>Arctostaphylos nevadensis</u>)
Bitterbrush	(<u>Purshia tridentata</u>)
Low sagebrush	(<u>Artemisia arbuscula</u>)
Indian ricegrass	(<u>Oryzopsis hymenoides</u>)
Western wheatgrass	(<u>Agropyron smithii</u>)

Hopefully we will have plant material ready for outplanting by this fall (mid-September). We have a few favors to ask - we would like to have housing in the ranger's dormitory during our stay; and we were wondering if we could get a pass for the entrance since we will be traveling in and out of the park during our stay.

Thanks for your help.

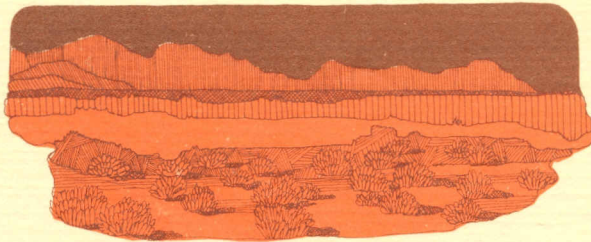
Sincerely,

Chris Call

Christopher A. Call

Utah State University · Logan, Utah 84322

Institute for Land Rehabilitation
UMC 52
Phone (801) 752-4100 x7266



College of Natural Resources
Agricultural Experiment Station

July 3, 1978

Mr. Thomas Henry
Assistant Chief, I&RM
Bryce Canyon National Park
Bryce Canyon, Utah 84717

Dear Tom:

Jerry and I would like to thank you for the accommodations during our stay at Bryce Canyon last week. It was a great help being so close to the overlook sites and a source of water for our soil infiltration studies. We completed the vegetation and infiltration studies at Fairyland, Sunrise Point, Inspiration Point, and Rainbow Point. The differences in plant cover, litter cover and soil compaction are quite significant when comparing low and high use areas at each site.

We are planning to return to Bryce Canyon during the week of September 11-15, 1978, to complete our vegetation and soil infiltration studies in the campground areas. We will also be planting rooted cuttings of manzanita, sagebrush and bitterbrush at that time. If possible, we would like to stay in the Ranger's Dorm or some other facility during our visit.

In a few weeks I will send a plan outlining the treatments and suggested planting sites for our September outplanting.

Thanks again for your help.

Sincerely,

Chris Call

Christopher A. Call

DEVELOPMENT/STUDY PACKAGE PROPOSAL

NO. 505

REVISION
NO.

ORG. NO. PARK (OR OTHER ORIGINATOR)

1330

Bryce Canyon

DEVELOPED AREA (NAME)

Park General

D.A. CODE

REGION

PG

RMR

STATE

Utah

STATE CODE

UT

COUNTY(S)

CONGRESSIONAL DISTRICT(S)

02

PACKAGE TITLE

TRAIL EROSION STUDY

STUDY PACKAGE

NEW CONSTRUCTION

REHABILITATION

☒B ☐A ☐

NEW

PACKAGE ☒REVISION ☐CRITERIA
(INSERT X's)1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
2 2 0

PARK PRIORITY

DATE

REG'N PRIORITY

DATE

PROGRAM THRUST, STATUS AND OTHER INFORMATION

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

WILL ADDITIONAL OPERATING FUNDS AND POSITIONS BE NEEDED UPON COMPLETION OF THIS PACKAGE?

IF YES EXPLAIN NEEDS IN SECTION XI OUTLINE OF PLANNING AND MANAGEMENT REQUIREMENTS)

YES ☐NO ☒

FULL PACKAGE DESCRIPTION:

This package will provide an evaluation of trail erosion through use of transect techniques designed to measure present conditions and to indicate future trends in erosion. Measurements would be made at eight different times over a two year period and Park personnel would be trained in erosion evaluation methods to permit continuation of the program after the initial study is completed.

Work to be done under contract with Utah State University.

PACKAGE JUSTIFICATION/CONSEQUENCES:

Bryce Canyon contains 64 miles of trails built along the highly erosive face of the amphitheaters. These trails require intensive maintenance. This research project would result in an inventory of the erosional losses on these trails and provide a systematic technique for appraising losses on trails. This information would permit the implementation of more reliable trail maintenance practices and would provide a basis for the development of alternative maintenance methods.

PLANNING AND MANAGEMENT REQUIREMENTS: (Follow Instructions and outline provided in Program Formulation Guideline)

Planning can proceed on the basis of this 10-238 and its supporting documents. This research program is included in the Resource Management Plan under proposed resource project number 3.

ORIGINATOR (Signature and Title)

DATE

CONCURRENCE (Signature of Supervisor or Equivalent Official)

DATE

Tom Kemp

2-14-78

Thomas D. Smith

2/14/78

RESEARCH PROSPECTUS

October 25, 1977

TITLE: A Study of Plant Community Changes at Bryce Canyon National Park from 1957 to 1978/9

INVESTIGATOR:

Hayle Buchanan, Professor of Botany
Weber State College
Ogden, Utah

I. BACKGROUND

In 1916 the Congress established the National Park Service and charged it with the task of preserving a system of national parks and national monuments in a primitive, natural condition. A few of these areas were in a pristine condition when they were included in the National Park System, but many of these areas had been altered through human exploitation. The ecosystem of the area included in Bryce Canyon National Park in 1928 had been modified by grazing, timber cutting, and other activities. Unfortunately no comprehensive inventories of the biological communities were made of this and most other areas when they became parts of the National Park System. Therefore, there was little scientific data on which to base evaluation of basic land management policies, regarding the soundness of these policies in accomplishing the original objectives of the park program.

During the period of 1957-1959, the investigator of this research proposal conducted a study to provide a quantitative and qualitative report on the nature, extent, and condition of the plant communities of Bryce Canyon National Park. A total of 320 permanently marked study plots were employed to secure data. Numerous photographs were taken and sampling data recorded so that the study could be repeated at intervals to obtain evidence of changing conditions and trends in these natural communities. An interim study was conducted in 1969 and 1970 using data from 200 of the original study plots to prepare an article for publication (see Appendix. Publication #12).

II. STATEMENT OF NEED

The National Park Service needs knowledge of vegetational succession in Bryce Canyon National Park. This knowledge may be useful in the assessment of land management policies.

III. OBJECTIVES

- a. Comparison of the present status of the plant communities with the results of the comprehensive phytosociological study of 1957-1959 and the interim study of 1969-70.
- b. Assessment of the effects of the practice of rigid fire protection of the present century in light of new developments in the role of fire in natural plant communities.
- c. Evaluation of insect and fungus disease control projects on changes in plant communities.
- d. Evaluation of the recovery of vegetation from overgrazing.
- e. Assessment of the impact of visitor use on the natural vegetation.

IV. PROCEDURE

The data on all 320 study plots will be re-mapped, measured and described. Data on trees adjacent to the plots will be updated from the 1957-59 Study to determine changes in the composition of forest stands. The one-third of the original plots that were photographed will be re-photographed. Increment cores will be taken from all fire-scarred trees and other evidences will be collected to reconstruct the pre-settlement fire history of the plant communities in the area. An analysis of past plant disease control projects in the forests of Bryce Canyon National Park will be made to evaluate the effects of forest manipulation on the present biotic communities.

V. PERSONNEL AND FACILITIES

Investigator: Hayle Buchanan, Professor of Botany, Weber State College (vita, attached, appendix).

Consultant: Dr. Kimball T. Harper, Dept. of Botany & Range Science, Brigham Young University.

Facilities: Supplied by Weber State College: vegetational sampling equipment, increment borers, dark room facilities, calculators, typewriters, computer facilities.

Needed: Use of 4x5 Graphflex camera, tripod, film, photo paper, darkroom facilities. Housing at Bryce Canyon National Park for investigator.

VI. TOTAL ESTIMATED COST

Salary, Investigator, 8 weeks	\$5,000.00
between July 1-Sept. 15, 1978	
10 weeks, summer 1979	

Consultant fee	500.00
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Photo Supplies	500.00
	\$6,000.00

PROBLEM ASSESSMENT AND VEGETATIVE REHABILITATION
OF VIEW POINTS AND CAMPGROUNDS
AT BRYCE CANYON NATIONAL PARK

a proposal to

National Park Service Cooperative Unit
at Utah State University

December 15, 1977

Submitted by

Cyrus M. McKell

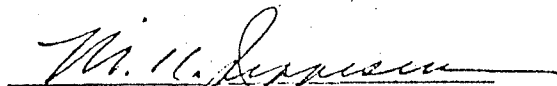
Professor of Range Science

Jerry Barker

Research Assistant

Chris Call

Research Fellow


Contracts Officer

I. Origin and Nature of the Problem

A. Introduction

Bryce Canyon National Park provides the opportunity for visitors to view nature's unusual blending of rock formations and vegetational communities. Because of these features, Bryce Canyon has become a popular attraction for recreational activities such as hiking, camping, and sight seeing. Yearly visitation totals have increased from 426,151 to 626,207 from 1972 to 1976. A further increase in numbers of visitors is expected during the next few years.^{1/}

Increased use of the scenic view areas and campground sites during the last several years has caused soil compaction and vegetational damage thus resulting in soil erosion and decreased aesthetic quality (Budge 1975). If a properly planned rehabilitation program is not undertaken in the near future the problem will continue to increase.

The most logical and natural rehabilitation method is the re-establishment of native plants on the disturbed sites and a plan to manage foot traffic for minimal soil impact. Establishing plant cover would help reduce erosion by increasing infiltration rates, adding soil organic matter and stabilizing the soil. Use of native plants would be compatible with the surrounding area and be aesthetically pleasing.

The purpose of the proposed study is two-fold: first, to assess the degree of view area and campsite degradation; second, to develop an appropriate rehabilitation program emphasizing the use of native plants.

^{1/} National Park Service records. Salt Lake City, Utah.

B. Literature Review

Research has shown that excessive or heavy visitor use in scenic areas, campgrounds and picnic sites may reduce their environmental quality. Heavy trampling by visitors can adversely alter the soil's physical properties. Unfavorable soil conditions such as increased bulk densities, reduced pore size, increased erosion, reduced organic matter and reduced infiltration have been shown to result from heavy use (Lutz 1945, Appel 1950, Lilley 1975). Reduced plant vigor and death have been attributed to trampling and soil compaction, resulting in a reduction of plant cover (Frissell and Duncan 1965). Natural reproduction is reduced by trampling, and seedling survival is poor on eroded, unstable or compacted soil. Plant species composition has also been shown to undergo a gradual change with continued use. La Page (1967) found on new campgrounds that the original plant cover undergoes a gradual succession. The less tolerant species die out while the more tolerant species increase. With continued severe use the tolerant species will die out also, leaving bare ground.

The loss of vegetation and soil erosion caused by trampling has resulted in decreased aesthetic quality for many recreational areas. However, with good management and proper maintenance of these areas the aesthetic quality can be improved (Echelberger 1971).

The natural processes of soil freezing and thawing have been shown to decrease soil bulk density and increase infiltration (La Page 1962). Adding organic matter such as sawdust, leaf litter or straw also can increase soil infiltration and reduce compaction (Frissell and Duncan 1965, Mannering and Meyer 1963). Swanson and Jacobson (1956) found that adding nitrogen fertilizer stimulates root growth

thus potentially reducing soil compaction. Paved roads, walkways etc. have been used to direct foot traffic away from critical areas and subsequently reduce soil compaction in areas of heavy use (Ripley 1965).

After studying vegetational changes associated with campground sites for five years, Echelberger (1971) found that well managed campsites deteriorated little. He attributed the success to 1) occasional plantings of native species, 2) good maintenance, 3) the use of shade tolerant plant species, and 4) not exceeding campground carrying capacity. Furthermore, plant communities can be strengthened by watering, fertilizing and seeding at critical times (Beardsley and Wagar 1971).

C. Justification

The present condition of major view sites at Bryce Canyon National Park and campgrounds calls for a study of ways to rehabilitate and ecologically manage them so that further deterioration does not occur. Figures 1, 2, and 3 show some of the typical problems such as bare soil areas, erosion rills and plants severely damaged by visitor traffic.

Information is needed on ways to accomplish revegetation and still have continued use of the areas. Methods for propagation of local plant species and establishment procedures appropriate to park conditions must be developed as a foundation for site rehabilitation recommendations.

II. Objectives

The objectives of this study proposal are to:

- A. Assess the nature and severity of degradation to vegetation and soil of the scenic view areas and campgrounds.

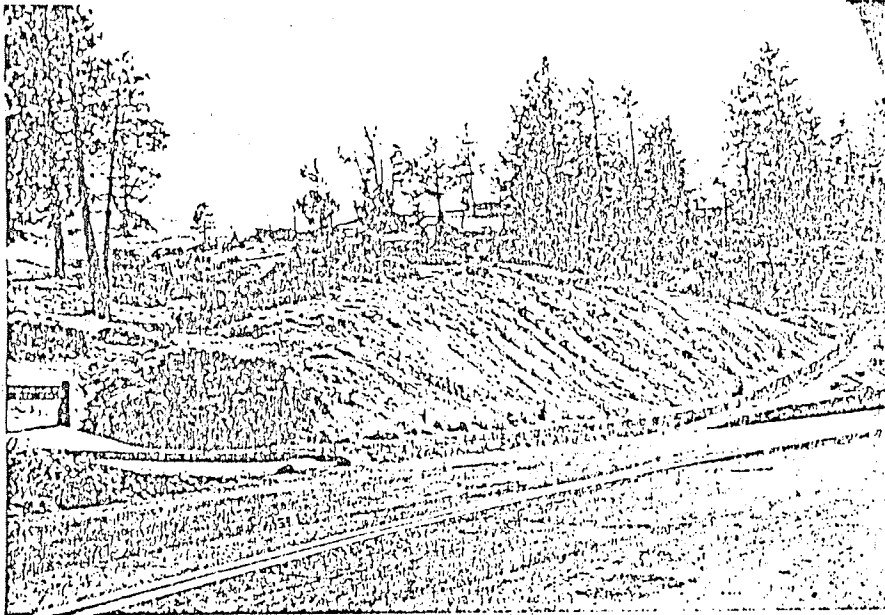


Figure 1. Eroded hillside at Inspection Point

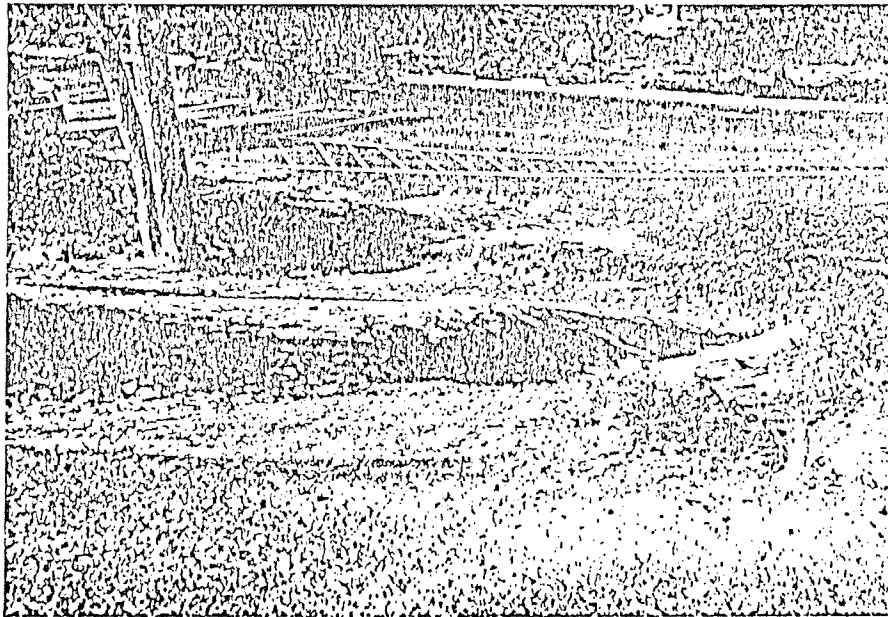


Figure 2. Erosion at Inspiration Point due to vegetation trampling and soil compaction.

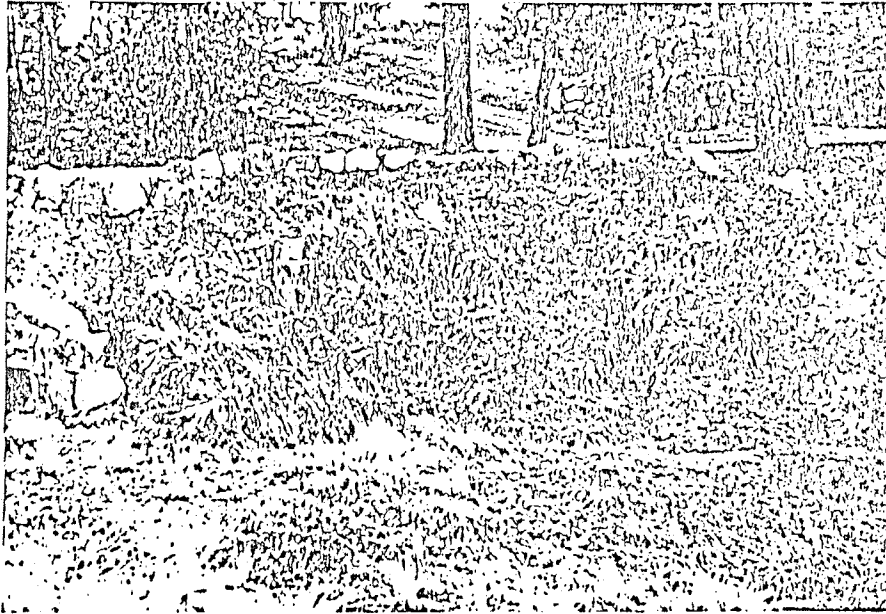


Figure 3. Erosion due to water run-off from road in campground. Now partially controlled.

B. Develop appropriate management procedures to alleviate soil compaction and erosion problems.

C. Determine plant species suitable for rehabilitating the scenic view areas and campgrounds.

D. Develop propagation methods for those native species that would be useful in rehabilitating the scenic view areas and campgrounds.

E. Develop plant establishment techniques compatible with continued use of the sites and present management program.

III. Methods

Assessment of the Problem

Prior to any detailed field assessment, project personnel in co-operation with National Park personnel will study heavy tourist-use areas of the park to evaluate management practices and perceived problems. If warranted, an in-depth discussion with park personnel would be undertaken either at this time or a later date to determine preferences and priorities visitors have for the aesthetic conditions they desire in a visit to Bryce Canyon National Park. After familiarization with the park physical environment and management objectives a detailed assessment of critical site conditions would be undertaken to determine the degree of departure from undisturbed conditions that has occurred under use.

The sampling method will be as follows:

A. High, medium and low intensity use areas and similar non use areas will be identified. Park personnel will be asked to help identify such areas. Each intensity of use area will be replicated five times.

B. Three randomly chosen transects (30 ft) will be established in each use class per replication. Vegetational and soil data will be obtained from the transects.

C. Analysis of variance will be used to determine statistical significance.

D. Physical and chemical soil data will be collected. Two sites per transect will be randomly chosen to obtain the soil data.

1. Water infiltration rate (cm/hr) will be measured by using an infiltrometer. Dry soils and soils prewetted to field capacity will be used. Each infiltrometer run will be thirty minutes with infiltration measurements being obtained every five minutes. A simulated rainfall intensity of 6 cm/hr will be used.

2. Sediment concentration (g/l) will be measured by evaporating a one liter integrated sample taken from the total runoff.

3. Bulk density will be determined using the Ring Method.

E. Vegetational data will be collected from the transects to determine.

1. Species composition and relative density for each use class.

2. Plant cover, rock cover and bare ground (%). These data would be obtained using the line-intercept method.

3. On the basis of data and observations obtained the project personnel will develop a list of suggested practices to prevent further damage to plants and soil deterioration caused by visitor use under existing management practices. The objectives are to develop a plan that will return the vegetation and soil parameters to those existing in the low or no use category.

Rehabilitation Studies

Where rehabilitation appears necessary a revegetation program would be developed. For this phase of the project to be successful, adapted species must be chosen. Species will be selected for study according to the following criteria:

- A. Ecologically adapted to disturbed site.
- B. Able to withstand abuse
- C. High in aesthetic quality.
- D. Provide ground cover and erosion control.
- E. Native to the park.

Seed and vegetation propagation will be used to obtain planting stock.

1. The existing literature will be reviewed for any reported methods for germinating seed of the chosen species. If a methodology is not available lab experiments will be conducted to develop techniques.

- a. Seed will be collected at the appropriate time.
- b. Seed will be cleaned and stored for future use.

2. The Institute for Land Rehabilitation has considerable experience in vegetatively propagated native plants. Existing literature on vegetative propagation of plant species native to the park will be reviewed, also. In the event that vegetative propagation techniques may need to be developed for the species chosen a program of study would be undertaken as follows:

Stem and root cuttings would be obtained of shrubs and forbs. Recent research has shown that factors such as season, type of cutting and greenhouse preparation methods may vary in their effect on

rootability among species. Several collections will be taken during the year to identify the best season to obtain cuttings for each species. Also several different techniques will be used for obtaining the most success in rooting of cuttings. After suitable techniques have been worked out for the desired plants an adequate number would be propagated in containers for use in field studies.

3. Container-grown transplants will be used because of their excellent field performance and low maintenance requirements after out-planting. Also, container grown plants will be able to withstand some abuse. However a method will have to be developed to prevent rodent damage. Plant establishment techniques will be compatible with continued use of the areas. This will be accomplished by careful planning and coordination with Park Service personnel.

Field Studies

A. The experimental design will be as follows:

1. Variables

(a) Spring and fall plantings.

(b) Water plus fertilizer (50 lbs/acre of nitrogen), water alone, and control.

(c) Cages, rodent repellent and control.

B. A randomized block design will be used with five blocks. Park personnel will be used to help identify the best place to establish the field plot.

C. Survival and growth will be the parameters measured for each plant.

Preparation of Reports

Problem analysis and site condition data, appropriate methods and practices for rehabilitation, plant propagation methods, and data from

the field establishment studies would be assembled and organized into a report suitable for use by Bryce Canyon National Park personnel.

In addition, it is anticipated that additional studies would be undertaken to provide the basis for a PhD dissertation. The exact nature of such additional studies would be determined after an in-depth problem analysis.

In any case, the dissertation would be devoted to problems of land rehabilitation and plant responses under the present environmental management of Bryce Canyon National Park.

IV. <u>Budget</u>	<u>Year 1</u>		<u>Year 2</u>		<u>Total</u>	
	<u>NPS</u>	<u>USU</u>	<u>NPS</u>	<u>USU</u>	<u>NPS</u>	<u>USU</u>
1. Personnel						
1. C. M. McKell ^{1/}		\$1,500		\$1,800		\$3,300
2. Jerry Barker/or						
3. Chris Call ^{2/}	\$4200		\$4300		\$8500	
4. Staff Benefits		360		450		810
2. Travel						
Trips to study site 2000			2000		4000	
3. Current expenses	800		800		1600	
Greenhouse Exp.	_____		_____		_____	_____
Total Direct Cost	\$8000	\$1860	\$7100	\$2250	\$14100	\$4110
Indirect Cost 10% ^{3/}	<u>700</u>	<u>2820</u>	<u>710</u>	<u>3050</u>	<u>1410</u>	<u>5870</u>
Total Cost	\$7700	\$4680	\$7810	\$5300	\$15510	\$9980

^{1/} Professor of Range Science and Director of the Institute for Land Rehabilitation. Services would be available as Major Professor of Graduate Student employed.

^{2/} Both Mr. Barker and Mr. Call are presently admitted for graduate studies at USU and are available to work on the proposed project. Other proposals include them however and only one student would be selected based on subsequent events.

^{3/} Indirect costs claimed as contribution by USU equals total personnel X 60% less amount contributed by NPS.

V. Time Schedule

The proposed study is outlined for a two-year period from April 1978 to April 1980. The following schedule outlines events during the two year study:

- A. Site analysis and orientation visits with park personnel would start as soon as the project is implemented and weather permits in early 1978.
- B. Plant materials will be collected for propagation every two months starting April 1978. Seeds will be collected when they are ready. Plant propagation studies will run throughout the two year period.
- C. Soil and vegetational data of use site will be collected June 1978.
- D. Fall field plot plantings will occur October 1978.
- E. Statistical analysis of data collected thus far will be made fall 1978.
- F. Seed germination tests will be accomplished during the winter 1979.
- G. Spring field plot plantings will be done May 1979.
- H. Survival and growth data will be measured October 1979.
- I. Statistical analysis of field plot data November 1979.
- J. Final report and recommendations due the end of March 1980.

VI. Facilities Available

The facilities available for this study include greenhouse space, laboratory space and equipment and two vehicles. The Institute for Land Rehabilitation has two different greenhouses in which to conduct the research. One greenhouse is set aside for vegetative propagation of native plants. The other greenhouse is set aside for growing and preparing plants for outplanting. Laboratory space and equipment for the seed germination studies is available through the Range Science Department.

VII. Literature Cited

- Appel, A.J. 1950. Possible soil restoration of "overgrazed" recreational areas. J. Forest. 48:368.
- Budge, A.C. 1975. Statement for management. Bryce Canyon National Park.
- Beardsley, W.G. and J.A. Wagar. 1971. Vegetation management on a forested recreation site. J. Forest. 69:728-731.
- Echelberger, H.E. 1971. Vegetative changes at Adirondack Campgrounds 1964 to 1969. U.S. For. Ser. Res. Note NE-12. N.E. For. Exp. Stat., Upper Darby, Penn.
- Frissell, S.S., Jr. and D.P. Duncan. 1965. Campsite preference and deterioration in Quetico-Superior Canoe Country. J. Forest. 63:256-260.
- La Page, W.F. 1962. Recreation and the forest site. J. Forest 60:319-321.
- La Page, W.F. 1967. Some observation on campground trampling and ground cover response. U.S. For. Ser. Res. Paper NE-68 N.E. For. Exp. Stat. Upper Darby, Penn.
- Lilley, D.W. 1975. A study of soil and vegetation at selected campgrounds in Baxter State Park and Acadia National Park. M.S. Thesis, Univ. of Maine at Orono. 117 p.
- Lutz, R.J. 1945. Soil conditions on picnic grounds in public forest parts. J. Forest. 43:121-127.
- Mannering, J.V. and L.D. Meyer. 1963. The effects of various rates of surface mulch on infiltration and erosion. Soil Sci. Soc. Amer. Proc. 27:84-86.
- Ripley, T.H. 1962. Recreation impact on Southern Appalachian campgrounds and picnic sites. U.S. For. Ser. Res. Paper SE-153. Southeastern For. Exp. Stat. Asheville, North Carolina.

VIII. Vitas of project personnel.

A. C. M. McKell

B. Jerry Barker

C. Chris Call

CURRICULUM VITA

Name:

Cyrus M. McKell

Biographical Listings

Who's Who in America
Who's Who in the World
American Men of Science

Birth:

Payson, Utah - March 19, 1926

Education:

BS 1949 University of Utah, Biological Science
MS 1950 University of Utah, Botany
PhD 1956 Oregon State University, Plant Ecology and Range Management
Postdoctoral Work, University of California, Davis

Employment:

Teaching Assistant, 1949-50, University of Utah
Administrative Officer, Medical Service Corps, U.S.A.F., 1951-52
Principal and Science Teacher 1952-53, Tabiona High School, Utah
Teaching Assistant, 1953-55, Botany, Oregon State University
Instructor, 1955-56, Botany, Oregon State University
Range Plant Physiologist, 1956-61, U.S.D.A. - A.R.S., at University
of California, Davis, California
Vice-Chairman and later Chairman, Agronomy Department, University of
California, Riverside 1961-69.
Head, Range Science Department, Utah State University, 1969-71
Director, Rockefeller Foundation-financed Environment & Man Program,
Utah State University, 1971 - 1976
Director, Institute for Land Rehabilitation, Utah State University, 1976-
Honors, Awards, and Professional Service:

Rockefeller Foundation Education Travel Grant, 1964, Africa
Fulbright Research Fellowship, Spain, 1968
Phi Sigma, Honorary Biological Society
Sigma XI
Dry Lands Research Institute, University of California, Advisory
Board and Project Leader, 1967-69
Member Editorial Board, Journal of Range Management, 1970 - 1973
General Chairman, International Symposium on Useful Wildland Shrubs,
Logan, Utah 1971
Program Chairman, Society for Range Management, International Meeting,
Reno, Nevada 1971
Lecturer in Range Management, the Technion Israel Institute of Tech-
nology Haifa, Israel 1968
Lecturer at the Grasslands Institute Hurley, Berkshire, England 1968
Assessor, Ad Honorem, Facultad de Agronomia, Universidad Nacional del
Sur, Bahia Blanca, Argentina 1971-73
Plenary Lecturer and member of Praxidium XIII International Grasslands
Congress, Leipzig, DDR.

Major Research:

Research has been directed to land-resources ecology and physiology of rangeland plants. Generally the emphasis is on factors which can be manipulated to enhance plant growth under range conditions. Plant response to sulfur, phosphorus, and nitrogen fertilization under stress conditions of temperature and moisture have been investigated. Several ecological studies of Taenatherum asperum, a weedy annual grass, contributed new information on this species. The role of fire as a management tool of weedy species has been a reoccurring subject of study. During the late 1960's work concentrated on studies of seedling vigor, carbohydrate reserves, and factors affecting growth of grasses and shrubs. Recent work is concentrating on land use planning and policies, plus research on revegetation of disturbed lands.

Publications:

121 publications to date (see publication list)
Co-Editor, "Biology and Utilization of Grasses" published by Academic Press in 1972.
Co-Editor, "Useful Wildland Shrubs", published by U.S. Forest Service and distributed world-wide.

Societies:

American Society of Range Management (president of California Section, ASRM, 1964)
American Society of Agronomy
Ecological Society of America
Western Society of Crop Science
Western Society of Soil Science
Phi Sigma Honorary, Biological Society (President of OSU Campus, 1955)
Sigma Xi (Secretary of UCR campus chapter, 1964)

Consulting Appointments:

Ford Foundation, Analysis of Arid Lands in Northern Mexico, 1965
Allen Chase. Agricultural Feasibility Study Northern Territory in Australia, 1963
Eckbo, Dean, Austin and Williams. Environmental Planning, Los Angeles State and County Park, 1966
Development and Resources Corporation, Sacramento, California. Director, Peace Corps Training Group for India in Agriculture, Summer, 1967
Ford Foundation, Range Resources Research and Development in Argentina at Universidad Nacional del Sur, Argentina, 1970-72
Western Electric, Environmental Education, 1972
USAID/Bolivia. Range Resources Development, 1971-72
Mt. Fuel Supply Company, Environmental Assessment of Pipeline on Montane Vegetation, 1973.
Utah Power & Light Company, Environmental Assessment of Powerline Project, 1974
VTN - Engineering Company for Sun, Phillips, and SOHIO Oil Companies, Baseline Study for Development of Oil Shale Tracts in Utah.
U.S. National Academy of Science/Brazilian Ministry of Planning - SUDENE Science and Technology in the Development of Agriculture in the Semi Arid Tropics, 1974
Hudson Basin Project. An Analysis of Regional Planning Needs, 1974
FAO, Rome, Italy, 1975. Spain 1975-76. Review of Rangeland Research.

Public Service:

President, International Relations Council, Riverside, California.
Special Representative Commission of the Californias (California, Baja California and Territory of Baja, California.
Panelist, Land Use Seminar on Southern California Deserts, University of California at Riverside, June 1969.
Member, Planning and Conservation League, California, 1969.
Chairman, University-wide Task Force on Controlling Blowing Sand in Coachella Valley, 1968-69.
General Chairman, Land Use Planning Colloquium, Utah State University, 1971.
Panel Coordinator, "Resource Utilization and Public Policy Administration," Phoenix, Arizona, November 1971.
Vice Chairman, Cache County Planning Commission, 1973.
Member of Advisory Committee, Utah's Community Progress.
Co-Leader, Regional Seminars in Land Use Planning.
Chairman, Cache County Planning Commission, 1974.
Member, Wasatch National Forest Advisory Committee.
Member, Advisory Committee, Upper Colorado Environmental Plant Materials Center, Meeker, Colorado.
Member, Energy Conservation and Development Council for Utah.

Professional Programs Organized

1. Grass Biology and Utilization. 1969. A University symposium at University of California, Riverside. Outcome was a textbook published by Academic Press (served as co-chairman).
2. International Shrub Symposium. 1971. Papers from a group of scientists from over eight countries and the U.S. formed the basis for a widely circulated Forest Service Technical Publication on shrubs (served as general chairman).
3. Environment and Man Program. 1971-75. This university-wide program of research education and outreach was funded by a major grant from the Rockefeller Foundation. Grants to stimulate meaningful faculty research on environmental programs was a major thrust of the program (served as Director).
4. Navajo Range Improvement Demonstration Project. 1975-76. This project was sponsored by a grant from the Ford Foundation to Navajo Community College and Utah State University. Activities consisted of short courses, a field day and a Demonstration Ranch at Chambers, Arizona (served as Director).
5. Regional Center for Continuing Education in Land Use Planning. 1976-77. A steering and action committee consisting of representatives from five states (Arizona, New Mexico, Colorado, Utah and Idaho) serve as the mechanism for sharing and disseminating information and planning activities designed to educate people on local and regional issues in land use (served as Director).
6. Institute for Land Rehabilitation. 1975-present. This research program serves as a focal point in studies of methods for land rehabilitation. An Agricultural Experiment Station project plus external contracts for research provides financial support for research (serve as Director).

Curriculum Vita

JERRY R. BARKER

Birth: Payson, Utah - January 22, 1951

Education:

High School	1969	Bountiful High School
B.S.	1975	Brigham Young University, Provo, Utah. Botany
M.S.*	1977	Utah State University, Logan, Utah. Range Ecology

Employment:

Undergraduate Research Assistant, Brigham Young University, 1974.

Greenhouse Assistant Manager, Brigham Young University, 1974-1975.

Graduate Research Assistant, Utah State University, 1975-1976.

Senior Research Assistant, Institute for Land Rehabilitation, Utah State University, 1976 to present.

Societies:

Xi Sigma Pi

Consulting Appointments:

Utah State University Foundation, Environmental Baseline Study of Utah Oil Shale Lease Tracts Ua and Ub, 1975-1977.

Publications:

Institute for Land Rehabilitation, 1977. Rehabilitation of western wildlife habitat, a state-of-the-art review. USU Foundation. (Author of several sections).

Wiebe, H.H., J. Barker and R.W. Brown (in press). Soil temperature gradient effects on in situ hygrometer measurements of water potential. Agron. J.

*Will complete this degree Fall quarter, 1977.

CURRICULUM VITA

Name:

Christopher A. Call

Birthdate:

May 25, 1951

Education:

B.S. 1973 University of Nevada, Reno, Plant Science

M.S. 1977 Oregon State University, Horticulture

Employment:

Greenhouse Technician, 1971-73, University of Nevada, Reno
Crop Extension Specialist, June-November, 1973, Peace Corps, Dominican Republic, medical termination
Instructor, 1974-75, Horticulture, University of Nevada, Reno
Teaching Assistant, 1975-77, Horticulture, Oregon State University
Research Assistant, 1977-present, Range Science, Utah State University

Honors and Awards:

Phi Kappa Phi Honor Society
Kerak Temple ROTC Award, 1970, University of Nevada, Reno
Mary S. Dalton Agriculture Scholarship, 1972, University of Nevada, Reno
Oregon Association of Nurserymen Ornamental Horticulture Scholarship, 1976, Oregon State University
National Science Foundation Graduate Traineeship, 1977, Utah State University

Major Research:

Research has concentrated on the propagation and adaptation of native plants for landscape and land rehabilitation use. Emphasis in the last three years has been on the mycorrhization of nursery plants prior to outplanting on harsh sites. At present, research is directed to the adaptation of native range plants to the adverse conditions of strip-mined areas and processed oil shale deposits.

Workshops Conducted:

Horticulture Teaching Workshop, June, 1976, Oregon State University

Publications:

Linderman, R.G. and C.A. Call. 1977. Enhanced Rooting of Woody Plant Cuttings by Mycorrhizal Fungi. HortScience (In Press).

Problem Assessment and Vegetative Rehabilitation
of View Points and Campground at Bryce Canyon National Park
Annual Report - 1978
by
Chris Call and Jerry Barker

RECEIVED BRYCE CANYON NP.	
JAN 12 '79	
Act	Int
☒	Superintendent
☒	Admin. Officer
☒	Chief, I&RM
☐	Visitor Serv.
☐	Interpretation
☒	Resource Mgt.
☐	Chief, Maint.
☐	R&T Foreman
☐	B&U Foreman
☐	Files

I. Introduction

Increased use of scenic view areas and campground sites at Bryce Canyon National Park during the last several years has caused soil compaction and vegetational damage resulting in soil erosion and decreased aesthetic quality. The problem will continue to increase if a properly planned rehabilitation program is not undertaken in the near future.

Information is needed on ways to rehabilitate and ecologically manage heavy use areas and still have continued use of the areas. Methods for propagation of local plant species and establishment procedures appropriate to park conditions must be developed as a foundation for site rehabilitation recommendations.

II. Objectives

The objectives for this year (1978) were to:

A. Assess degradation to vegetation and soil of scenic overlook areas and campgrounds.

B. Select and propagate native plant species suitable for rehabilitating scenic areas and campgrounds.

C. Develop plant establishment techniques compatible with continued use of sites and present management program.

III. Methods

A. Assessment of problem

Project personnel visited Bryce Canyon National Park in April to familiarize themselves with the park physical environment and management practices. After touring the park with park personnel, scenic overlook and campground sites were selected for vegetation and soil analysis, and plant establishment studies. High and low use areas were identified at Fairland Overlook, Sunrise Point, Inspiration Point, Rainbow Point, North Campground and Sunset campground. A non use area was also selected to determine the degree of departure from undisturbed conditions. Three randomly chosen line-intercept transects (20 meters) were established in each use class at each site in June. Vegetation composition and cover, water infiltration rates, sediment production, and soil bulk density measurements were obtained from each transect.

B. Selection and Propagation of Native Plant Species

After viewing the heavy use areas, native plant species were selected for the revegetation program according to the following criteria:

1. Ecologically adapted to the disturbed site.
2. Ability to withstand use
3. Provide ground cover and erosion control
4. Aesthetically pleasing

Selected plant species include:

1. Greenleaf manzanita (Arctostaphylos patula)
2. Bitterbrush (Purshia tridentata)
3. Low sagebrush (Artemisia arbuscula)
4. Mountain common juniper (Juniperus communis)
5. Mountain snowberry (Symphoricarpos oreophilus)

6. Western wheatgrass (Agropyron smithii)
7. Indian ricegrass (Oryzopsis hymenoides)

Stem cuttings of manzanita, bitterbrush, sagebrush and juniper were taken during April, June, September and October to determine the best season to obtain cuttings for each species. Snowberry cuttings will be taken next February.

Bitterbrush and manzanita seed were collected in September and October respectively. The seed are now being stratified for early spring sowing. Bitterbrush, western wheatgrass and Indian ricegrass seed were obtained from a native seed collector in Ephraim, Utah for early spring sowing. Cuttings obtained from the April collection date were rooted in a peat-perlite medium under mist in the greenhouse. Rooted cuttings were placed in containers approximately three months prior to outplanting in September. Container grown plants were favored over bare-root plants because of their excellent field performance and low maintenance requirements.

C. Plant Establishment

Outplanting sites were selected at Fairyland Overlook (sagebrush), Sunrise Point (manzanita, bitterbrush) and Farview Overlook (manzanita, juniper) on the basis of available planting area, accessibility for maintenance and data collection, and management of foot traffic. Container-grown plants from the April cutting collection date were outplanted in these field plots in early September. Variables in the randomized block design included:

1. Fertilizer (50 lbs/acre N and P), no fertilizer
2. Inoculation with native soil (50 cc/container), no inoculation
3. Cages for rodent and tourist control, no cages

All plants were measured for initial height and irrigated with one liter of water after treatments were applied. Survival and growth parameters were measured in early October.

IV. Results

Since all the data collected during 1978 have not been completely analyzed, representative examples of one campground and one scenic overlook will be discussed.

A. Plant cover and composition

An important factor in the prevention of erosion is the maintenance of vegetative cover. At this time, only total plant cover will be discussed in relation to erosion potential on the three different use areas. Total cover is the percentage of three transects intercepted by grasses, forbs and shrubs. Litter constitutes the percentage of transects intercepted by fallen needles and twigs, dead plants, etc. Bareground is the percentage of the transects not occupied by live plants or litter.

Results show that low-use areas in North Campground and Fairyland Overlook have a higher percentage of plant cover and litter than high-use areas (Table 1). The total plant cover of the non-use area is approximately the same as the two low-use areas. As one would expect, the percentage of bareground in high use areas at both sites is much greater than in low-use and non-use areas. The low percentage of bare ground on the non-use area can be explained by the high percentage of litter.

B. Physical characteristics of soil

Water infiltration data also show the importance of vegetative cover and litter in the prevention of soil erosion and site degradation. Runoff after a simulated rainfall (6 cm/hr) was generally greater on high use areas at both sites (Figures 1 and 2). The graphs demonstrate the

great variability between infiltration rates on transects within the same use area. This variability is due to differences in vegetative cover, amount of litter and bare ground, slope/aspect, and concentration of foot traffic. Runoff was non existent on the non-use area (Figure 3) due to the high percentage of vegetative cover and the very high percentage of litter.

Soil bulk density measurements (Table 2) and sediment production data (Table 3) show the effects of extensive foot traffic on soil compaction and the deterioration of plant and litter cover. Soils of high-use areas at both sites were more compacted than low and non-use areas, and produced more sediment in runoff after a simulated rainfall.

In conclusion, increased use of scenic view areas and campground sites during the last several years has caused vegetational damage and soil compaction resulting in decreased aesthetic quality and a high potential for soil erosion. The problem will continue to increase if a properly planned rehabilitation - management program is not undertaken in the near future.

V. Future Objectives

A. Continued development of plant establishment techniques -- comparison of spring and fall planting of container-grown plant material.

B. Develop appropriate management practices to prevent further damage to plants and soil caused by visitor use under existing management practices.

VI. Timetable of Future Activities

Year 1979

February -- collection of hardwood cuttings for June outplanting.

June -- outplanting in field plots at Fairyland Overlook, Sunrise Point, and Farview Overlook; record growth and survival data from September, 1978 outplanting; conduct visitor survey for attitudes concerning park use, existing management practices, and proposed management techniques.

September -- record growth and survival data from September, 1978 and June 1979 outplantings.

October through December -- analysis of vegetational data, physical soil data, water infiltration data, and growth and survival data.

Year 1980.

January through April -- work on preliminary draft of final report.

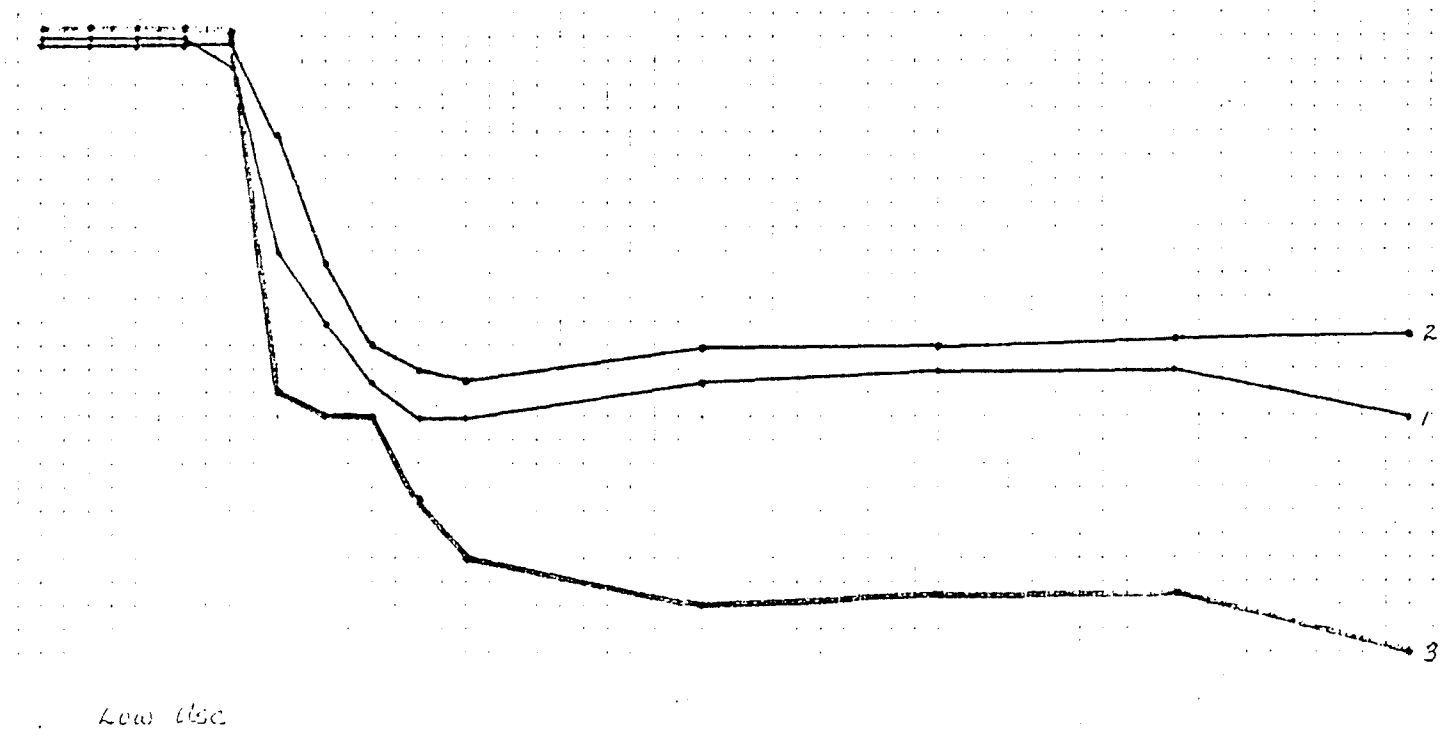
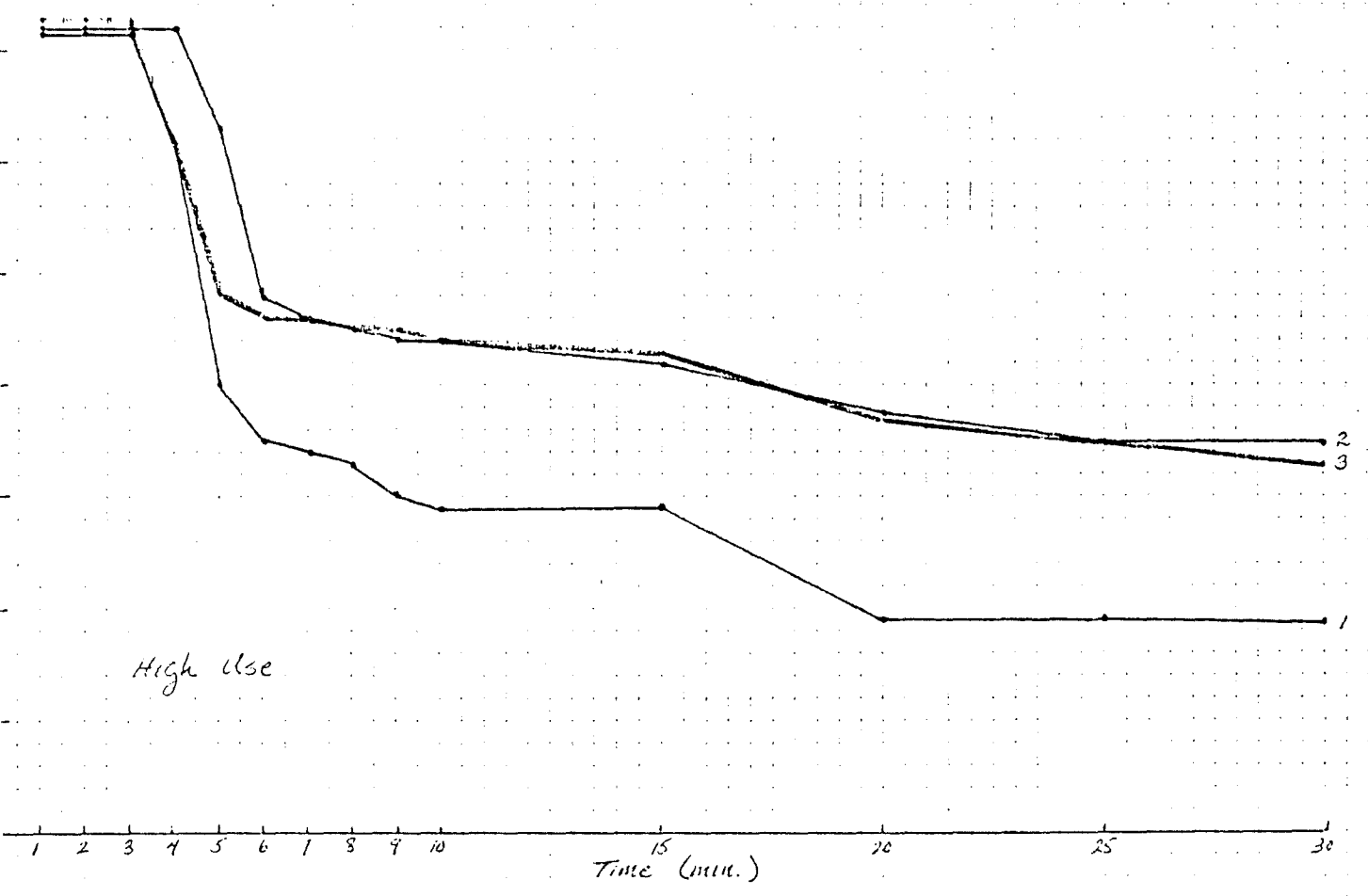
April -- record final growth and survival data from September, 1978 and June, 1979 outplantings.

May -- finish up final report for review and distribution.

Table 1. Percentage of transect intercepted by plant, litter and bare-ground for low and high use areas at North campground and Fairyland overlook. The non-use area is given as a means of comparison.

<u>SITE</u>	<u>Percent of Transect Intercepted</u>	
	<u>Low</u>	<u>High</u>
<u>North Campground</u>		
Total plant cover	29.1	11.2
Shrub	18.8	6.5
Forb	3.8	2.2
Grass	6.5	2.6
Litter	39.5	9.9
Bareground	31.4	78.9
<u>Fairyland Overlook</u>		
Total plant cover	40.6	14.9
Shrub	26.4	2.3
Forb	2.1	2.5
Grass	12.1	10.1
Litter	17.2	11.1
Bareground	42	74
<u>Non-use Area</u>	<u>Percent of Transect Intercepted</u>	
Total plant cover	30.2	
Shrub	28.7	
Forb	0.5	
Grass	1.0	
Litter	64.3	
Bareground	5.5	

Effect of work on blood pressure in normal subjects at high and low work at Northampton.



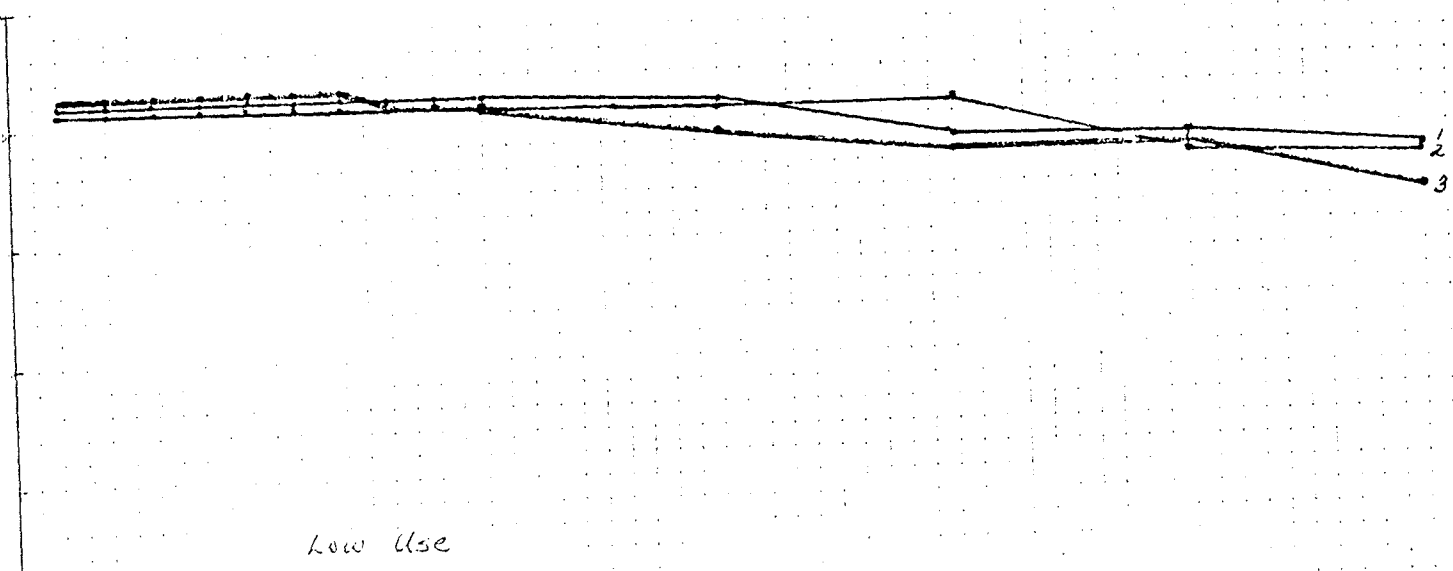
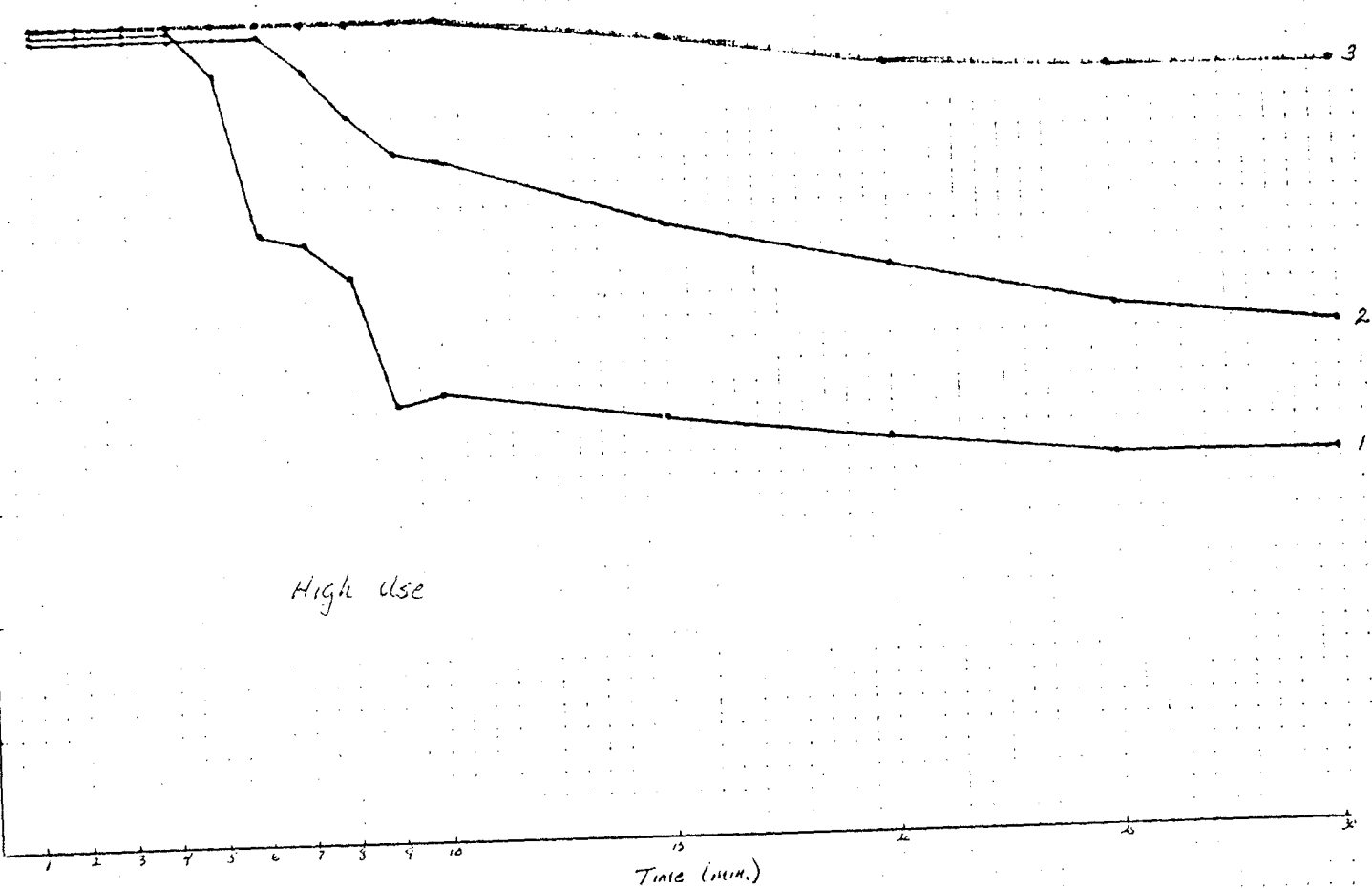


Figure 2. *Indication after a simulated rainfall (1 cm/hr.) in a non-use area near Paradise Point.*

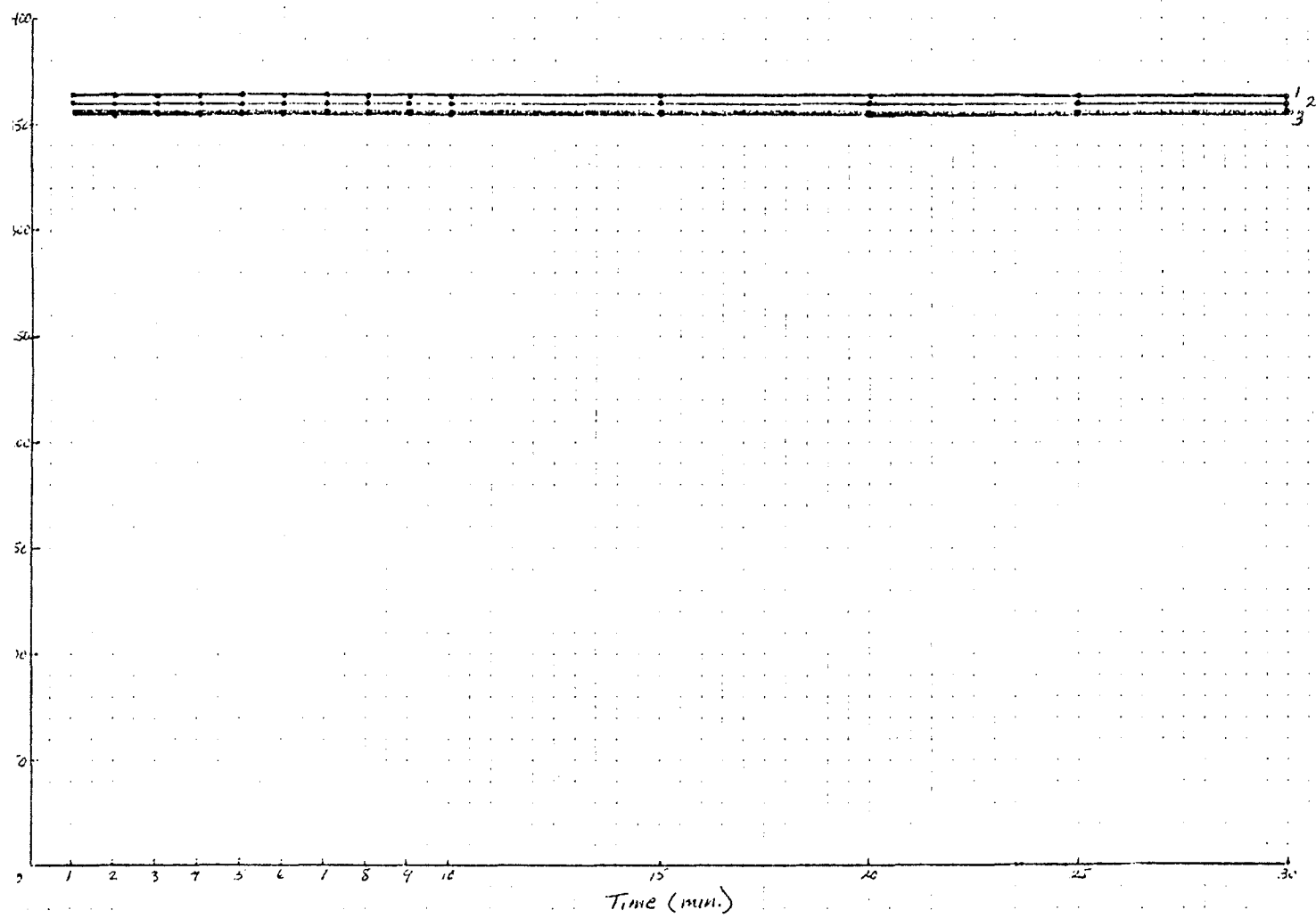


Table 2. Bulk density of soils of different use areas at Fairyland Overlook and North Campground.

Site	Bulk Density (g/cm ³)		
	High Use	Low Use	Non Use
Fairyland Overlook			0.8
Transect #1	1.60	1.50	
Transect #2	1.20	1.20	
Transect #3	1.30	1.40	
North Campground			0.8
Transect #1	1.22	1.16	
Transect #2	1.25	1.23	
Transect #2	1.45	0.99	

Table 3. Sediment concentration of runoff at different use areas at Fairyland Overlook and North Campground.

<u>Site</u>	<u>Sediment Concentration (g/l)</u>		
	<u>High Use</u>	<u>Low Use</u>	<u>Non Use</u>
Fairyland Overlook			0.00
Transect #1	1.34	0.49	
Transect #2	0.98	0.33	
Transect #3	2.33	1.23	
North Campground			0.00
Transect #1	1.35	0.75	
Transect #2	1.83	0.79	
Transect #3	3.94	0.77	