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The Nature Conservancy

GREAT BASIN FIELD OFFICE Pioneer Station PO Box 11486 Salt Lake City, Utah 84147-0486 (801) 531-0999

Fred J. Fagergren
Superintendent
Richard Bryant
Resources Management Specialist
Bryce Canyon National Park
USDI National Park Service
Bryce Canyon, Utah 84717

December 17, 1993

Gentlemen:

As you may know, we thanked the Natural History Association by letter for enabling Allan Daly's trip to the planning workshop early last month. Allan reported his attendance and brought back many useful answers to questions I had. We are likewise grateful to you both for inviting a Conservancy representative. Allan's interest in your area of Utah was kindled, and he may be back at some future time on a study project.

Our remarks in this letter appear in two parts. The first addresses the upshot of the November meeting. The second responds to your November 9 letter concerning a Paunsaugunt Plateau management group. Toward the letter's conclusion, a potential area of overlap between the two concerns is mentioned.

We will remain interested in the prospects for special designations (SDs) within Bryce. Park Service guidance is of course undergoing intensive review. Richard, and Dan Foster, attended the December 8 SD meeting in Lakewood.

Pending issuance of the policy (clarifying differences among the existing titles), our thoughts are the following:

* The Park staff could nominate, with its scientific cooperators, one or more "themes" identified for representation. An RNA to protect and showcase the theme(s) could occur within the Park. Plausible, readily appreciated examples might be the Claron Formation breaks or a ponderosa pine habitat type.

* We prefer to think of a Research Natural Area or Protected Natural Area within Bryce as an affirmative management tool and a contribution to the NPS' Plateauwide system rather than as a burdensome imposition. Our involvement would surely be to ensure this! "Healthy skepticism" is warranted when we collectively talk about a highly restrictive Park subzoning, one that may necessitate locally closing out an ever more mobile and growing public.

SOUTHERN NEVADA PROJECT OFFICE PO Box 70838 Las Vegas Nevada 89170 (702) 737-8744

WESTERN REGIONAL OFFICE 2060 Broadway, Suite 230 Boulder, CO 80302 NATIONAL OFFICE 1815 North Lynn Street Arlington, VA 22209

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*Our premise has always been that the Conservancy should do the bulk of the fieldwork and documentation to enable the "supervised" nomination and eventual establishment of a federal natural area. The usual venue has been a Challenge Cost Share (CCS), or simply cost-shared, project. Specific details can be worked out later, but we certainly plan to contribute in whatever way is necessary if SD candidates within Bryce receive preliminary affirmation. What I will explore is a CCS project involving two or three of: Bryce, Capitol Reef, and Cedar Breaks.

*Speaking of the four areas we studied and wrote up a few years ago, a tentative reckoning might be that "North Fairyland Bench" and "Mud/Noon Canyon" are chiefly of local significance and thus more appropriately Protected Natural Areas. "Bristlecone Point" and Boat Mesa might correspond to the more regionally-determined themes and could thus deserve Research Natural Area consideration.

I have several thoughts in response to the November 9th letter. You solicited ideas on an interorganizational management group -- a "forum for stakeholders" in public resources -- on the Paunsaugunt Plateau. In western Garfield County, the Conservancy wears several hats. We are a Panguitch-area landowner, a proponent/monitor of Research Natural Areas and Botanical Areas on the Dixie National Forest (DNF), and the surveyors of the four Park relict areas reported in 1991.

* The geographical forum could be the Southern High Plateaus, a recognized physiographic subdivision of Utah (Utah Geological and Mineral Survey Map 43, by William Lee Stokes). Significantly, the Utah Department of Environmental Quality has chosen Stokes' scheme for its long-range Strategic Planning Initiative. The Comparative Risk Analysis will look at each of the subdivisions and conclude an assessment of "stressors" and their magnitude.

* Whatever the delimitation, it should be multicounty because the Park is in two counties. The mentioned subdivision extends into Piute as well as Kane counties

* One issue could be implementation of approved Endangered or Threatened species recovery plans -- or joint actions to obviate the need to list some of the abundant "C2" taxa of your region.

* A state lands representative is surely needed. There is a nearly unbroken "block of blue" extending north from the Park. We are developing the idea of offering stewardship services for trust holdings whereon rare plants grow and animals live. The Widtsoe Junction block could be a prototype, depending on the rarities (plus good plant community examples) present.

* The group's deliberative focus could perhaps be resolvable, "transboundary" issues where greater equity, economy in the use of land restrictions, and mutual understanding between "conservation" and "development" interests are promoted.

* The Moab area with its two parks is an acknowledged Colorado Plateau "flashpoint" undergoing the stresses and uncertainties of exploding recreational use. Could the Paunsaugunt group promote "proactive", rather than "emergency", arrangements to forestall or at least blunt the effect of these trends, here? Moabites have gone the coordinated management plan route in at least one instance. Over there, community leaders are pulling together federal, city, county, and nonprofit interests to tackle challenges beyond any one entity's capabilities.

* Boundary-related issues are, I imagine, one of the main motivators for the Park's promotion of the management group concept. Without advocating Park expansion or the creation of buffer zones, we do suggest that consequences of Bryce's very high perimeter-to-area ratio need definition and discussion. Conservation biologists could lend insights, using the criteria of fragmentation, insularity, connectivity, etcetera.

* The area's flora has a distinct subset of listed, Category 2, and 3C-yet-still-noteworthy plants. I propose that the group determines what this subset consists of, and then goes about seeing how monitoring and special designation work can be "farmed out" to promote comprehensiveness and efficiency.

* Two established natural areas occur in the greater area: Table Cliff and Red Canyon. The Conservancy and the DNF's Powell Ranger District are working on a promising special interest tract, which would be called the Claron Botanical Area when designated. We suggest that the group take cognizance of these in-place and impending designations, and promote some unity of purpose.

Keeping the acreage of land set aside is an important consideration in Garfield County. At the same time, a desirable goal would be the inclusion of at least one occurrence of each of the "special" plants in a formal, monitored natural area. Early calculations showed that "Bristlecone Point" could provide a refugium for a couple of taxa (species or varieties) not noted in the established, DNF areas.

To respond to one of your requests -- I am willing to serve as the primary contact person for The Nature Conservancy. I've no preferences for a meeting place, but Panguitch might prove especially "central" for most of the participants and some of the meetings. How about twice a year, Spring and Fall?

Thank you indeed for these opportunities to comment. We look forward to continuing and strengthening a good working relationship, and to helping Bryce staff in any way you think it is appropriate.

Sincerely yours,

Nick Van Pelt

Nicholas Van Pelt
Utah Public Lands and Stewardship Programs

pc: Chris Montague, Director of Conservation Programs, GBFO
Joel Tuhy, Colorado Plateau Public Lands Project Director
Allan Daly, Colorado Plateau Public Lands Project Volunteer

Nature BibID # 122869

FINAL REPORT

for

Cooperative Agreement CA 1440 8-8001
Survey and Analysis of Relict Plant Communities
Within National Park System Units of the Colorado Plateau

***** VOLUME II *****

COMMUNITY SITE DESCRIPTIONS AND UNIT ANALYSES

Bryce Canyon National Park, Utah
Capitol Reef National Park, Utah
Cedar Breaks National Monument, Utah
Zion National Park, Utah

---

by

Nicholas S. Van Pelt
Great Basin Field Office
The Nature Conservancy
Salt Lake City, Utah

Charles D. Schelz
Salt Lake City, Utah

Joel S. Tuhy
Utah Natural Heritage Program
Utah Department of Natural Resources
Salt Lake City, Utah

John R. Spence
Formerly Volunteer in the Park
Capitol Reef NP
Torrey, Utah

for

Rocky Mountain Regional Office
USDI National Park Service
Lakewood, Colorado

June 1991

ERRATA

Volume II
Bryce Canyon NP/Capitol Reef NP/Cedar Br aks NM/Zion NP

Survey and Analysis of Relict Plant C mmunities...

Page	Clarification or Corr ction
Various (plant list tables)	*"dumosa"* should be *"dumosus*
	"Amelancher" should be *"Ame anchier"*
	"salina" or *"salinas"* shoul be *"salinus"*
38, 99	*"Zygadenus"* should be *"Ziga lenus"*
	"Lithispermum" should be *"L .thospermum"*
	"montana" should be *"monta is"*
	"Symphoricarpus" should be *'Symphoricarpos"*
99	*"Saxifragus"* should be *"Sa ifraga"*
109	Map caption should read "T i-Story Canyon"

*

INTRODUCTORY SECTION

*

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We thank the resource-management staffs of the four national parks and monuments for their interest and assistance: Therese Johnson at Bryce Canyon, Tom Henry and Steve Robinson at Cedar Breaks, Norm Henderson and Sandy Bortwick with Capitol Reef, and Larry Hays of Zion. Therese arranged comfortable temporary housing in the pines of Bryce. At Capitol Reef, Norm and Sandy graciously allowed us to use the library, herbarium, kitchen and shower at the Griffith House.

Dr. Kimball Harper of Brigham Young University was a prime mover in the Zion studies. Kim's interest and authority lent valuable perspectives to the writeups from the park's mesas. Dr. Neil West of Utah State University shared recollections and insights from his and his students' work there, as well. Darrell Stubbs of Classic Helicopters afforded safe transportation to and among the Zion sites.

Catherine Jean and her husband Jay shared essential information about sites of Cedar Breaks. Jay led the senior author to overlooks in September 1989 and discussed their work of the preceding summer.

We are most grateful to Charles (Chuck) Wood and Dr. Robert (Bob) Schiller of Glen Canyon NRA and the Rocky Mountain Regional Office, respectively. Chuck and Bob were supportive, wise and patient collaborators, and we thank them deeply.

SUMMARY

The northern part of the Colorado Plateau contains a renowned, scenic group of national parks, monuments and reservoir-based recreation areas. They extend from Zion National Park in southwestern Utah to Mesa Verde NP in southern Colorado, and north to Dinosaur National Monument where Colorado, Utah and Wyoming meet. Bryce Canyon, Capitol Reef and Zion national parks, plus Cedar Breaks National Monument (NM), are situated in southwestern or south-central Utah. Their colorful beauty attracts visitors from all over the world.

The landscapes of these Park System units exhibit a variety of vegetation formations and types. Small places with pristine plant communities are common where topography has kept out motor vehicles and domestic livestock. These relict areas have many scientific, educational and resource-management uses. After documentation, the best of them may be placed in a network of protected reserves for Colorado Plateau ecosystems.

In 1989 and 1990, The Nature Conservancy and the Park Service sponsored surveys of over fifty relict sites, under terms of a cost-sharing Cooperative Agreement. The Conservancy had previously reported a helicopter-based inventory of sites in Glen Canyon National Recreation Area. The purpose of the present work was to produce, in several volumes, a comprehensive catalog of relict sites within all other parks in southern Utah and western Colorado. Five formal objectives have governed the surveys, beginning with compilation of a vegetation classification to denote communities encountered in the field.

This volume is one of six in the Cooperative Agreement's final-report series. It provides illustrated descriptions of relict sites within Bryce Canyon, Capitol Reef, Cedar Breaks, and Zion. Almost all sites are unreported elsewhere. Overflights, topographic maps, and reconnaissance generated a dynamic list of places to inspect on foot in the summer and early fall of 1990.

Field methods included compilation of plant species lists; correlation of features with the classification; notes on geology, landforms, relict character, and disturbance; vegetation sampling; and repeatable color photography. Slide panoramas obtained with a tripod, placed over permanent ground stations, are archived in Volume V of the final-report series.

The narrative section of this volume contains descriptions and analyses of four, seven, four and six places in Bryce, Cedar Breaks, Capitol Reef and Zion respectively. The concluding section presents recommendations for management and further study, plus an appraisal of the sites' potential value to an expanded, Plateau-wide system of research natural areas.

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INTRODUCTION

The northern Colorado Plateau extends across w stern Colorado and the southern half or so of Utah. Including only a small part of northernmost Arizona, the northern Plateau is nearly synonymous w th the Colorado Plateau Ecoregion of Omernik and Gallant (1987). From Zion n southwestern Utah to Mesa Verde in southern Colorado, and north to Dinosa r near Wyoming, is a renowned ensemble of national parks, monuments, and eservoir-based recreation areas. The National Park Service (NPS) administers ll of these units[1].

Bryce Canyon, Capitol Reef and Zion national p rks, and Cedar Breaks National Monument, occupy the west-central and weste n parts of the northern Plateau. Technically, Bryce and Cedar Breaks are si uated on adjoining, heavily forested highlands, not in the semiarid Eco egion proper.

In addition to spectacular scenery and first-c ass cultural resources, the units have a wide variety of vegetation formatic ns and plant community types. Comparatively small places with pristine rel ct communities abound, on or in buttes, mesas, steep, timbered mountainsides, narrow canyons, and near-badlands. Lacking economic resources, these places escaped postsettlement impacts. They are often impassable to livestock an motor vehicles, and unattractive or unknown to tourists.

The term "relict" refers to communities that have either 1) persisted despite the prounounced warming and drying of the i terior West over the last few thousand years (Betancourt 1984); or 2) have no been influenced by settlement and postsettlement activities, chiefly d mestic stock grazing. Relict areas are often scientifically interesting b cause of their isolated faunas and verifiable lack of human interference (J hnson 1986; Turner 1990).

For the land manager, relicts serve as a stan ard or "baseline" for gauging impacts occurring elsewhere in the parks (H rmann 1990; Jeffries and Klopatek 1987), help define the productive potentia s of forests and rangelands (Passey, Hugie and Williams 1982), and a e sanctuaries for plant and animal life (sometimes including endangered or hreatened species). Sites can be outdoor classrooms for students and educator , provided visitation impacts are negligible. The most exemplary and sec rely protectable areas can contribute to Plateau-wide [Arizona, New Mexico, Co orado and Utah] or state-based systems of designated ecological reserves (Va Pelt 1992).

To learn more about NPS-administered relict s tes[2] and to foster their preservation, recognition and appropriate use, the Park Service and The Nature Conservancy (TNC) entered into a Cooperative Agree ent (CA) in 1988. The purpose of the sponsored surveys and analysis was t o produce a complete, evocative and uniform catalog of relict sites with n park units. Surveys of Glen Canyon National Recreation Area occurred in 1 86 and 1987 (Tuhy and MacMahon 1988). They were an authoritative preced nt for extending the same perspective and methods to other units in southwes -central Utah, southeastern Utah, northeastern Utah, and western Colorado. Ul imately, the cooperators hoped, all Arizona and New Mexico units would also be surveyed.

---

1. "Unit" as used here and throughout this volume efers to a national park, monument, or recreation area, never to a relict area directly. Following accepted in-Service practice, we o ten refer to a monument or a recreation area as "the park" when its ide tity is already clear.

2. "Site", "area" and "place" are used almost inte changeably for relict-community occurrences, with area to b construed as referring to larger ones (for example, of several hund ed acres).

The broader goal to which the CA contributes i creating a network of protected areas on federal (chiefly NPS) lands on th Colorado Plateau of the four states. Fulfillment will require formal design tion of some of the surveyed sites, and both surveys and designation ini iatives in the Southwest later on. The CA project goals, and both principal nd supplementary objectives, appear on page 3 below.

This volume is devoted to Bryce Canyon, Capito Reef, Cedar Breaks, and Zion. It provides illustrated writeups of relict si es, then an appraisal of their value for expansion of Utah and Plateau resear h natural area (RNA) networks. In many instances the surveys were the fi st inspections undertaken of these places--access is often only gained by auth rized helicopter landings or by arduous climbing. Because much work took plac in the spectacularly eroded country of Bryce and Capitol Reef, most of ou sites have high scenic and interpretive as well as ecologic interest.

In brief, the CA calls for TNC to: 1) generate a vegetation classification system to be used in field descriptio ns and the "network" analysis; 2) draw up a list of potentially relict si es; 3) carry out surveys, and report the characteristics of the sites. Report s are to be followed by advice on appropriate management and zoning.

The NPS (regional and unit levels) was obliga ed to help compile the list, provide coordination including entry authoriz tions, and reimburse the Conservancy for services and products rendered. Th Conservancy's contribution to the project cost-share formula cons sted of a leased truck, tools, contract-assistant fees and expenses, office space, and experience gained in nearly ten years of similar surveys on nc -NPS lands of Utah.

The governing vegetation classification was d vised by Glen Canyon report author J. Tuhy in consultation with P. Bourg ron, the Conservancy's regional ecologist (Bourgeron and Tuhy 1989). We p esent an abbreviated version in this volume (Table II.1; pages 4-23). T e table lists only those types encountered in the surveys--or believed to be present in the Ecoregion and on nearby High Plateaus with parks (for example Cedar Breaks NM and Bryce Canyon NP). That is, wholly Southwestern types wer deleted.

We drew up a master list of sites to inspect, after flying over Capitol Reef in a small plane, perusing topographic maps fo cliff-rimmed places in particular, and asking unit staffs and academic re earchers for leads. The list was a dynamic one, subject to additions and de etions as surveys proceeded. Several times, we spotted likely sites while enroute between areas on the list, and added them to our current itinera ies.

Our methods were primarily descriptive in na ure, geared to compilation of narratives supported by color photographs, larg -scale topographic maps, and plant species lists. The main adjunct to the writeups is a collection of color-slide panoramas taken from permanently-marke ground stations. The photographs are archived with technical data in th companion report to this one, project Volume V. Details of methods appear n pages 25-28 below.

A "unit profile" precedes the site writeups or each unit. Partly derived from NPS planning documents (for example, RNP 1984), the profiles describe geographic, geologic, administrative, vis tation and planning contexts. Factors favoring or disfavoring the per istence of relict areas are cited.

We describe four areas of Bryce Canyon, seve in Capitol Reef, four in Cedar Breaks, and six atop unscalable mesas in Zio . Authors Van Pelt and Schelz visited areas within all units except Zion. Spence contributed writeups and data from Capitol Reef, and Tuhy surv yed all Zion sites with helicopter support.

PROJECT GOAL AND OBJECTIVES

Only a fraction of the vegetation types documented in the classification have a protected example, whether in the NPS units of the northern Plateau or on surrounding, multiple-use lands where RNAs are establishable. Accordingly, filling the gaps is an unfinished task. It comprises the overarching goal of the Cooperative Agreement and any extensions of it to Arizona and New Mexico (NPS Western and Southwestern regions). The objectives are steps along the way of this long-term aspiration. Of necessity it will involve the Bureau of Land Management, the United States Forest Service, and tribal governments in the years after 1991.

The Cooperative Agreement specified the primary project objectives as having The Nature Conservancy:

(1) Generate a comprehensive classification of Colorado Plateau vegetation types.

(2) Determine which of those types are and are not adequately represented in the existing natural area system.

(3) Develop a listing of known and potential relict areas within National Park Service [System] units in the Colorado Plateau.

(4) Conduct field inventories to assess the qualifications of as many of the potential sites as possible.

(5) Prepare reports that evaluate the significance of each of the potential sites.

The <u>analysis</u> phase of the project consists of determining how the sites together help advance the goal. Their "qualifications" must merit research natural area status. Also, the vegetation types they exemplify should not be well represented elsewhere. Sites not worthy of further consideration as research natural areas might still be significant to the administering unit. They could likewise be useful in an ongoing or prospective research study or a baseline/monitoring program. We feel that installation of photopoints in itself makes each host site valuable to posterity, even if its park zoning status is not to change (Schelz and Van Pelt 1990).

We identified a few supplemental objectives after the first season of fieldwork, and in response to in-Service developments since the CA was signed. None of the following is obligatory, but each of them seemed both timely and achievable within the project's constraints:

(6) Publicize the sites' utility and (subject to entry restrictions in some instances) availability for synoptic, long-term, or mission-oriented studies. (Some Plateau resource managers suggest that the units of the region would be fine "platforms" for investigation of the impacts of atmospheric change on North American deserts and semideserts).

(7) Provide the administering units with sound information about areas to avoid, close or buffer while carrying out maintenance, interpretive, trail construction, or building work.

(8) Build an outstanding archive of relict-area scenes that future managers and students of the Colorado Plateau can rephotograph for comparison. Ensure that the resolution of most of the pictures enables individual-plant-based analysis of vegetational and geomorphological changes over the ensuing decades.

Table II.1 Abridged vegetation classification for the northern Colorado Plateau. Source: Bourgeron and Tuhy (1989). The upper-case, four-letter codes following the names of nearly all types are derived from the first two letters of the generic name and specific epithet for the denoting plant species.

-- Coniferous Forests --

ABIES CONCOLOR SERIES

* Abies concolor/Acer glabrum
ABCO/ACGL

Pine Valley, Tushar and Abajo Mountains of southern UT; widespread throughout the mountains of the Southwest

* Abies concolor/Arctostaphylos patula
ABCO/ARPA

Throughout southern UT

* Abies concolor/Arctostaphylos uva-ursi
ABCO/ARUV

Northern NM and southern CO

* Abies concolor/Berberis repens
ABCO/BERE

Widespread in AZ, CO, NM, UT

* Abies concolor/Cercocarpus ledifolius
ABCO/CELE

Sporadic in Pine Valley Mountains and high plateaus of southern UT

* Abies concolor/Erigeron eximius
ABCO/EREX

Widespread in NM and southern CO

(Table II.1, continued)

* Abies concolor/Festuca arizonica
ABCO/FEAR

Widespread in AZ, southern CO, NM

* Abies concolor/Juniperus communis
ABCO/JUCO

Minor in the Sevier and Paunsaugunt Plateaus and Escalante and Tushar Mountains of UT

* Abies concolor/Quercus gambelii
ABCO/QUGA

Widespread throughout AZ, southern CO, NM, and UT

* Abies concolor/Symphoricarpos oreophilus
ABCO/SYOR

Northern NM and northern AZ into CO, and on the Wasatch, Aquarius and Paunsaugunt Plateaus in UT

ABIES LASIOCARPA SERIES

* Abies lasiocarpa/Aconitum columbianum (riparian)
ABLA/ACCO

High plateaus of central and southern UT, and LaSal Mountains of southeastern UT

* Abies lasiocarpa/Acer glabrum
ABLA/ACGL

Central and southern UT, more common farther north

* Abies lasiocarpa/Berberis repens
ABLA/BERE

High plateaus and LaSal and Abajo Mountains in UT

(Table II.1, continued)

* Abies lasiocarpa/Carex geyeri
ABLA/CAGE

Incidental in the LaSal and Abajo Mountains of southeastern UT; also in central CO

* Abies lasiocarpa/Carex rossii
ABLA/CARO

High plateaus of central and southern UT

* Abies lasiocarpa/Juniperus communis
ABLA/JUCO

AZ (North Kaibab Plateau), into UT, ID, WY, and possibly in northern NM

* Abies lasiocarpa/Ribes montigenum
ABLA/RIMO

High plateaus and mountains of central and southern UT

Thalictrum fendleri phase occurs in Cedar Breaks Nat'l Mon.

* Abies lasiocarpa/Vaccinium myrtillus
ABLA/VAMY

AZ, southern CO, NM, LaSal Mountains of UT

PICEA ENGELMANNII SERIES

* Picea engelmannii/Ribes montigenum
PIEN/RIMO

Aquarius and Markagunt Plateaus and Tushar Mountains of southern UT

PICEA PUNGENS SERIES

* Picea pungens/Berberis repens
PIPU/BERE

(Table II.1, continued)

Highlands of central and southern UT

* Picea pungens/Equisetum arvense (riparian)
PIPU/EQUAR

Aquarius and Paunsaugunt Plateaus of southern UT

* Picea pungens/Juniperus communis
PIPU/JUCO

Highlands of central and southern UT

* Picea pungens/Potentilla fruticosa (riparian)
PIPU/POFR

Paunsaugunt Plateau of south-central UT

PINUS FLEXILIS-PINUS LONGAEVA SERIES

* No specific associations identified.

Topoedaphic climax on high plateaus of central and southern UT, west of the Colorado/Green Rivers

PINUS PONDEROSA SERIES

* Pinus ponderosa/Arctostaphylos patula
PIPO/ARPA

High plateaus and LaSal and Abajo Mountains of southern UT, and into southwestern CO

* Pinus ponderosa/Artemisia arbuscula or A. nova
PIPO/ARAR

Southern CO, northern NM, southern UT
Prominent north of Bryce Canyon National Park

* Pinus ponderosa/Arctostaphylos uva-ursi
PIPO/ARUV

Northern NM, southern CO

* Pinus ponderosa/Bouteloua gracilis
PIPO/BOGR

(Table II.1, continued

Widespread in AZ, CO, NM

* Pinus ponderosa/Cercocarpus ledifolius
PIPO/CELE

Minor on the Markagunt and Sevier Plateaus and Pine Valley Mountains of southern UT, and Tavaputs Plateau of central UT

* Pinus ponderosa/Festuca arizonica
PIPO/FEAR

Widespread in southern CO

* Pinus ponderosa/Muhlenbergia montana
PIPO/MUMO

Southwestern and central NM to CO, central AZ to UT

* Pinus ponderosa/Quercus gambelii
PIPO/QUGA

Widespread in AZ, CO, NM, and UT

* Pinus ponderosa/Quercus undulata
PIPO/QUUN

Rare in southern Colorado

* Pinus ponderosa/Purshia tridentata
PIPO/PUTR

Southern UT

* Pinus ponderosa/Symphoricarpos oreophilus
PIPO/SYOR

Local on the Aquarius Plateau and Abajo Mountains of southern UT

PSEUDOTSUGA MENZIESII SERIES

* Pseudotsuga menziesii/Arctostaphylos patula
PSME/ARPA

Paunsaugunt and southern Fishlake Plateaus and Escalante and Boulder Mountains of southern UT

(Table II.1, continued)

* Pseudotsuga menziesii/Berberis repens
PSME/BERE

Southern Utah

* Pseudotsuga menziesii/Cercocarpus ledifolius
PSME/CELE

Minor on highlands of southern and central UT, more common farther north

* Pseudotsuga menziesii/Cercocarpus montanus
PSME/CEMO

Minor on highlands of central and southern UT

* Pseudotsuga menziesii/Festuca arizonica
PSME/FEAR

Local in southern CO

* Pseudotsuga menziesii/Quercus gambelii
PSME/QUGA

Widespread in NM, AZ, southern CO, and southern UT

* Pseudotsuga menziesii/Symphoricarpos oreophilus
PSME/SYOR

Highlands of southern and central UT north into northern UT, ID, WY, and MT

SCARP-SCREE ASSOCIATIONS

* Pseudotsuga menziesii/Holodiscus dumosus Scree)
PSME/HODU

Throughout southern Colorado; prominent in canyons of the Gunnison River

-- Deciduous Forests --

ACER NEGUNDO SERIES

* Acer negundo/Cornus sericea (riparian)
ACNE/COSE

(Table II.1, continued)

Incidental on the high plateaus of central UT, and the LaSal Mountains of southeastern UT

ALNUS INCANA SERIES

* Alnus incana/Cornus sericea (riparian)
ALIN/COSE

Minor on high plateaus of central UT and the LaSal Mountains of southeastern UT

* Alnus incana/Equisetum arvense (riparian)
ALIN/EQAR

* Alnus incana/Mesic Forb (riparian)
ALIN/MESIC FORB

Minor on the Wasatch Plateau and the Abajo and LaSal Mountains of UT

BETULA OCCIDENTALIS SERIES

* Betula occidentalis/Cornus sericea (riparian)
BEOC/COSE

High plateaus of central and southern UT

POPULUS ANGUSTIFOLIA SERIES

* Populus angustifolia/Betula occidentalis (riparian)
POAN/BEOC

Minor on the high plateaus of central and southern UT

* Populus angustifolia/Cornus sericea (riparian)
POAN/COSE

Minor on the high plateaus of central and southern UT, and the LaSal Mountains of southeastern UT

* Populus angustifolia/Rhus aromatica (riparian)
POAN/RHAR

(Table II.1, continued)

Minor on the high plateaus of central and southern UT, and the LaSal and Abajo Mountains of southeastern UT

* Populus angustifolia/Rosa woodsii (riparian)
POAN/ROWO

Abajo and LaSal Mountains of southeastern UT

POPULUS FREMONTII SERIES (var. wislizenii)

Widespread throughout the southwest

POPULUS TREMULOIDES SERIES

* Populus tremuloides/Amelanchier alnifolia-Symphoricarpos oreophilus/Tall Forb
POTR/AMAL-SYOR/TALL FORB

A few scattered stands in southern UT

* Populus tremuloides/Artemisia tridentata
POTR/ARTR

Fishlake National Forest in UT

* Populus tremuloides/Calamagrostis rubescens
POTR/CARU

Infrequent in central and southern UT, more common in eastern ID and western WY

* Populus tremuloides/Carex rossii
POTR/CARO

Common on the high plateaus of central and southern UT, especially the Sevier and Fishlake Plateaus

* Populus tremuloides/Festuca thurberi
POTR/FETH

Fishlake, Sevier and Aquarius Plateaus of southern UT

* Populus tremuloides/Pteridium aquilinum
POTR/PTAG

(Table II.1, continued)

One stand on the Markagunt Plateau of southwestern UT

* Populus tremuloides/Sambucus racemosa
POTR/SARA

Incidental in central and southeastern UT (Wasatch Plateau and Abajo Mountains)

* Populus tremuloides/Stipa comata
POTR/STCO

High plateaus of southern and central UT

* Populus tremuloides/Symphoricarpos oreophilus/Calamagrostis rubescens
POTR/SYOR/CARU

LaSal and Abajo Mountains (but not the high plateaus) of southern UT, more common in eastern CO and western WY

* Populus tremuloides/Symphoricarpos oreophilus/Carex rossii
POTR/SYOR/CARO

High plateaus of southern UT (Fishlake and Dixie National Forests)

* Populus tremuloides/Symphoricarpos oreophilus/
Festuca thurberi
POTR/SYOR/FETH

Fishlake and Aquarius Plateaus of southern UT

* Populus tremuloides/Symphoricarpos oreophilus/Tall Forb
POTR/SYOR/TALL FORB

Infrequent on the Colorado Plateau; more common in northern UT, northern NV, and western WY

* Populus tremuloides/Symphoricarpos oreophilus/Thalictrum fendleri
POTR/SYOR/THFE

Highlands of central and southeastern UT

* Populus tremuloides/Tall Forb
POTR/TALL FORB

(Table II.1, continued)

Widely scattered on the high plateaus of central and southern UT, as far southeast as the Abajo Mountains and as far southwest as the Markagunt Plateau; common in northern UT, northern NV, and western WY

* Populus tremuloides/Thalictrum fendleri
POTR/THFE

Scattered on the Colorado Plateau, more frequent farther north

* Populus tremuloides-Abies concolor/Symphoricarpos oreophilus
POTR-ABCO/SYOR

High plateaus of central and southern UT, primarily on the Wasatch Plateau south to the Aquarius and Markagunt Plateaus

* Populus tremuloides-Abies lasiocarpa/Amelanchier alnifolia
POTR-ABLA/AMAL

Incidental in the Abajo Mountains of southeastern UT, more common in northern UT and eastern ID

* Populus tremuloides-Abies lasiocarpa/Carex geyeri
POTR-ABLA/CAGE

Highlands of central and southern UT as far southeast as the Abajo Mountains

* Populus tremuloides-Abies lasiocarpa/Carex rossii
POTR-ABLA/CARO

Common on the high plateaus of central and southern UT

* Populus tremuloides-Abies lasiocarpa/Juniperus communis
POTR-ABLA/JUCO

High plateaus of southern UT (Dixie and Fishlake National Forests)

* Populus tremuloides-Abies lasiocarpa/Symphoricarpos oreophilus/Tall Forb
POTR-ABLA/SYOR/TALL FORB

Infrequent on the high plateaus of southern and central UT, more common in northern UT

(Table II.1, continue)

* Populus tremuloides-Abies lasiocarpa/Symp oricarpos oreophilus/ Thalictrum fendleri
POTR-ABLA/SYOR-THFE

Incidental on the high plateaus of c ntral and southern UT

* Populus tremuloides-Abies lasiocarpa/Tall Forb
POTR-ABLA/TALL FORB

Infrequent in southern UT, more comm n farther north, especially in western WY

* Populus tremuloides-Abies lasiocarpa/Thal ctrum fendleri
POTR-ABLA/THFE

Infrequent on the high plateaus of s uthern and central UT, more common farther north

* Populus tremuloides-Picea pungens cover t pe
POTR/PIPU

High plateaus of southern and centra UT, and the south slope of the Uinta Mountains

* Populus tremuloides-Pinus flexilis cover ype
POTR/PIFL

Scattered on the highlands of centra and southern UT, mostly in eastern NV

* Populus tremuloides-Pinus ponderosa cover type
POTR/PIPO

Mountains and high plateaus of extre e southern UT (especially the Markagunt Plateau), nd south slope of the Uinta Mountains

* Populus tremuloides-Pseudotsuga menziesii Amelanchier alnifolia
POTR-PSME/AMAL

One stand in the LaSal Mountains of outheastern UT, more common farther north

* Populus tremuloides-Pseudotsuga menziesii Symphoricarpos oreophilus
POTR-PSME/SYOR

(Table II.1, continue)

Incidental on Aquarius Plateau of so thern UT

* Populus tremuloides-Pseudotsuga menziesii Juniperus communis
POTR-PSME/JUCO

Infrequent on the High Plateaus of s uthern and central UT

-- Woodlands --

JUNIPERUS OSTEOSPERMA SERIES

* Juniperus osteosperma/Amelanchier utahens s
JUOS/AMUT

* Juniperus osteosperma/Artemisia tridentat
JUOS/ARTR

Juniperus osteosperma-Pinus edulis/Cercoc rpus
ledifolius var. intricatus
JUOS-PIED/CELEIN

Eastern UT, including Arches Nationa . Park

PINUS EDULIS SERIES

Pinus edulis/Amelanchier utahensis
PIED/AMUT

Roan Plateau of CO

* Pinus edulis/Artemisia tridentata
PIED/ARTR

JUOS Ph. from southwestern CO and so thern UT into northern AZ and north-central NM, JU O and JUSC Ph. from northern NM into southern CO

* Pinus edulis/Bouteloua gracilis
PIED/BOGR

Widespread in AZ, NM, southern CO, a d southern UT Central and northern AZ into southea stern UT - Butler Wash, and southwestern CO, local in vestern NM

(Table II.1, continued)

* Pinus edulis/Coleogyne ramosissima
PIED/CORA

* Pinus edulis/Poa fendleriana
PIED/POFE

Northern AZ, southern UT, southwestern CO, northern NM

* Pinus edulis/Purshia tridentata
PIED/PUTR

Northwestern NM, southwestern CO

* Pinus edulis/Cercocarpus montanus
PIED/PUTR

Southeastern AZ, NM, southern CO

QUERCUS GAMBELII

* Quercus gambelii/Amelanchier alnifolia
QUGA/AMAL

-- Shrublands --

ARTEMISIA CANA SERIES

* Artemisia cana/Deschampsia cespitosa
ARCA/DECE

Fishlake Plateau of south-central UT

* Artemisia cana/Festuca ovina
ARCA/FEOV

Fishlake and Wasatch Plateaus of south-central and central UT

ARTEMISIA TRIDENTATA SERIES

* Artemisia tridentata/Agropyron spicatum
ARTR/AGSP

(Table II.1, continued)

* Artemisia tridentata-Atriplex confertifolia
ARTR-ATCO

* Artemisia tridentata/Bouteloua gracilis
ARTR/BOGR

* Artemisia tridentata/Elymus cinereus
ARTR/ELCI

* Artemisia tridentata-Ephedra viridis
ARTR/EPVI

* Artemisia tridentata/Poa secunda
ARTR/POSE

* Artemisia tridentata/Hilaria jamesii
ARTR/HIJA

ATRIPLEX CANESCENS SERIES

* Atriplex canescens-Artemisia tridentata
ATCA/ARTR

* Atriplex canescens/Hilaria jamesii
ATCA/HIJA

ATRIPLEX CONFERTIFOLIA SERIES

* Atriplex confertifolia/Hilaria jamesii
ATCO/HIJA

Atriplex confertifolia/Elymus salina
ATCO/ELSA

Scattered small stands in Grand County, UT

ATRIPLEX CORRUGATA SERIES

* Atriplex corrugata Shale Barren
ATCORR

ATRIPLEX GARDNERI SERIES

(Table II.1, continued)

Atriplex gardneri/Elymus salina
ATGA/ELSA

Grand Valley of western Mesa County, CO

* Atriplex gardneri/Xylorhiza venusta
ATGA/XYVE

* Atriplex gardneri/Hilaria jamesii
ATGA/HIJA

Western Mesa County, CO and eastern Grand County, UT

CERCOCARPUS MONTANUS SERIES

* Cercocarpus montanus/Agropyron spicatum
CEMO/AGSP

COLEOGYNE RAMOSISSIMA SERIES

* Coleogyne ramosissima/Ephedra viridis
CORA/EPVI

* Coleogyne ramosissima/Hilaria jamesii
CORA/HIJA

CORNUS SERICEA SERIES

* Cornus sericea/Heracleum lanatum (riparian)
COSE/HELA

Incidental on the high plateaus of central and southern UT

COWANIA MEXICANA SERIES

* Cowania mexicana/Agropyron spicatum
COME/AGSP

EPHEDRA VIRIDIS SERIES

* Ephedra viridis/Hilaria rigida
EPVI/HIRI

(Table II.1, continued)

POTENTILLA FRUTICOSA SERIES

* Potentilla fruticosa/Deschampsia cespitosa (riparian)
POFR/DECE

High plateaus of southern UT, especially the Paunsaugunt Plateau

SALIX BEBBIANA SERIES

* Salix bebbiana/Mesic Graminoid (riparian)
SABE/MESIC GRAM

Minor on the Aquarius Plateau and Abajo Mountains of southern UT

SALIX BOOTHII SERIES

* Salix boothii/Carex aquatilis (riparian)
SABO/CAAQ

Minor on the Wasatch Plateau of central UT

* Salix boothii/Carex nebrascensis (riparian)
SABO/CANE

Incidental on the Paunsaugunt Plateau of south-central UT

* Salix boothii/Carex rostrata (riparian)
SABO/CARO

Wasatch Plateau of central UT

* Salix boothii/Mesic Forb (riparian)
SABO/MESIC FORB

High plateaus of central UT, and Lasal and Abajo Mountains of southeastern UT

* Salix boothii/Mesic Graminoid (riparian)
SABO/MESIC GRAM

High plateaus of central and southern UT

(Table II.1, continued)

SALIX EXIGUA SERIES

* Salix exigua/Bar (riparian)
SAEX/BAR

Lowlands up through mid-montane zones on the Colorado Plateau

* Salix exigua/Mesic Forb (riparian)
SAEX/MESIC FORB

One stand on the eastern side of the Aquarius Plateau in south-central UT

* Salix exigua/Mesic Graminoid (riparian)
SAEX/MESIC GRAM

Minor on the high plateaus of central and southern Utah

SALIX GEYERIANA SERIES

* Salix geyeriana/Carex aquatilis (riparian)
SAGE/CAAQ

Sporadic on the high plateaus of southern UT

* Salix geyeriana/Deschampsia cespitosa (riparian)
SAGE/DECE

Minor on the high plateaus of central UT

* Salix geyeriana/Mesic Forb (riparian)
SAGE/MESIC FORB

Minor on the high plateaus of southern UT

* Salix geyeriana/Mesic Graminoid (riparian)
SAGE/MESIC GRAM

Paunsaugunt and Markagunt Plateaus of southern UT

SALIX PLANIFOLIA SERIES

* Salix planifolia/Carex aquatilis (riparian)
SAPL/CAAQ

(Table II.1, continue)

Fishlake Plateau of south-central UT

SALIX WOLFII SERIES

* Salix wolfii/Carex aquatilis (riparian)
SAWO/CAAQ

Scad Valley on the Wasatch Plateau o central UT

* Salix wolfii/Deschampsia cespitosa (ripar an)
SAWO/DECE

Wasatch Plateau of central UT

SARCOBATUS VERMICULATUS SERIES

* Sarcobatus vermiculatus/Distichlis strict .
SAVE/DIST

Usually heavily affected by grazing

-- Desert and Montane Grass ands --

HILARIA JAMESII SERIES

* Hilaria jamesii grassland
HIJA

Canyonlands National Park

ORYZOPSIS (STIPA) HYMENOIDES SERIES

* Oryzopsis hymenoides-Psoralidium lanceola :um loose sand grassland
ORHY-PSLA

STIPA COMATA SERIES

* Stipa comata grassland
STCO

(Table II.1, continue)

Aquilegia micrantha-Mimulus eastwoodiae h nging gardens -- AQMI/MIEA

* Arenaria obtusiloba-Paronychia pulvinata- ilene acaulis-Trifolium nanum alpine fellfield

Alpine zones on the Colorado Plateau and Rocky Mountains; LaSal and Uinta Mountains UT, Wheele Peak NM

* Caltha leptosepala (riparian)
CALE

Minor on the high plateaus of centra and southern UT

* Carex aquatilis (wetland/riparian)
CAAQ

Mountains of western US; high platea s of central and southern UT

* Carex lanuginosa (riparian)
CALA

Minor on the Wasatch Plateau of cent al UT and the LaSal Mountains of southeastern UT

* Carex microptera (riparian)
CAMI

Minor on the high plateaus of centra and southern UT and the Abajo Mountains of southeastern T

* Carex nebrascensis (riparian)
CANE

Scattered in the mountains of the we tern US; high plateaus of central and southern UT

* Carex rostrata (wetland/riparian)
CARO

Widespread in montane and subalpine ones of western US

* Carex simulata (riparian)
CASI

Incidental on the Wasatch Plateau of central UT

(Table II.1, continued)

* Eleocharis palustris (wetland/riparian)
ELPA

Scattered on the Wasatch Plateau of central UT, and in the Canyonlands section of southeastern UT

*

FIELD METHODS

*

IDENTIFICATION OF POTENTIAL RELIC ' SITES

Objective (3) of the preceding section called :or a list of relict areas. As many of them as possible were to be visit :d or their qualifications resolved by other means. We first drew on research :eports for all four units, especially Bryce and Zion. Doing so generate l few leads but bolstered confidence that those sites were worthwhile, having net the investigators' needs for seclusion (for example, Madany and West 19 34).

We next asked unit staff (including rangers, w no often go to remote sections on patrol and rescues) for suggestions. Th ese were forthcoming from the smaller units where full comprehension of terra n and use history are possible. Capitol Reef, however, necessitated a fi ed-wing flight because even staff of long tenure had not been to many corne rs of the park. Before fieldwork in 1990, we inspected 7 1/2-minute quadra gles for a clearer picture of barriers and access, plus additional site leads.

Bryce Canyon and Cedar Breaks are far smaller than Capitol Reef. Most any spot within them is accessible after three hour ' walking at most. We concentrated on mappable places of at least 100 acr s or so. Generally, we could not survey micro-sites of a few acres without making our job overwhelming. Nonetheless, we observed no rigid up er or lower size limit.

In some instances, we arrived at areas to fin that a disqualifying agent was present but that the features were still orthy of some reportage. We termed these "non-relict special cases". We usu lly provided an abbreviated writeup with ample warning about past i cursions as we inferred or were told about them. Although the Conservancy and the NPS considered RNA-quality sites to be highest-priority, we sought out and documented a good many other ones. Those could not contribute to the evol ing network (hence the overall goal) for reasons of size, barrenness or re undancy. Still, we felt that the units should know about and map them for t eir own administrative needs.

As we mentioned, the lists for the units repo ted in this volume (as in the other two) went through successive approximatio s. The Cooperative Agreement contained no stipulations regarding the m ximum or minimum number of sites for the project's timeframe and budget. We a preciably expanded the list by talking with seasonal rangers, reconnoiter g from overlooks, and scrutinizing advance, large-scale topo sheets. We ere not forbidden to visit nor discouraged from visiting any places. Also, di sclosure of no surveyed area is withheld from the following narratives.

Along with Canyonlands (reported in Volume I) , Capitol Reef warrants further work at a finer spatial scale. A wholly ne v survey could cover the tops, benches, and slots in the intricate Waterpoc et Fold, each a few acres or less in extent. Such an extension of our surve could be more explicitly founded on specific monitoring needs the CRNP reso ce management staff foresees. Similarly, but a much larger scale, the mesa tops within Zion are an incomparable scientific resource. Work atop th n has largely been limited by helicopter logistics. We suggest that emplacem nt of permanent photo stations there would be a quite desirable extensio of our work within the other units (Schelz and Van Pelt 1990).

FIELD METHODS

Determination of Relict Character

Having arrived at a site on the list, we promptly assessed the likelihood that humans had ever influenced its vegetation. We often could make confident and rapid decisions in Capitol Reef and Zion. Free-standing buttes and mesas constituted the simplest cases; for example 7176 Mesa and Timber Top Mountain. Dropped off by a helicopter or able to clamber up ourselves, we were sure that no cow, sheep, packtrain, mountain bike, jeep, tractor, or fixed-wing aircraft had ever preceded us.

Upper Deep Creek, Tri-Story Canyon, and Bristlecone Point were intermediate cases: plenty of precipitous terrain and clifflines, but conceivably some passageways livestock had used to reach the drainage bottoms and gentle slopes. Still other sites simply lacked any barriers to livestock or vehicular entry even if intrusions were long ago or, from today's perspective, implausible. An element of subjectivity was therefore present in deciding whether places in either category were pristine.

Disqualifying evidence included old fences, stock ponds or tanks, stumps, jeep trails and prospecting scars. Not inherently vegetation-altering, all signified that livestock could probably have followed the same route in as whoever was busy with cowboying, woodcutting or mining. Range cattle are amazingly adept at penetrating even the brushiest and rockiest of canyons. Thus, well into the surveys we concluded that (with quite rare exceptions) a site's vegetation is relict only when it enjoys <u>decisive</u> topographic protection. Low ledges, a lack of signs of cattle and sheep, unit boundary fences, and remoteness from stock water and range developments are insufficient guarantees unless imposing natural barriers are also present. We spent very little more field time within disqualified sites unless we noticed features of redeeming interest.

Accordingly, <u>absolutely</u> relict areas are only some of the total reported here; the rest's qualifications hinge on a judgement that impact was unlikely or transient. In any case, in our writeups we maintained a strict division between "pure" and "not so sure" sites, so as not to mislead future investigators whose hypotheses may require totally undisturbed situations. As we mention at other points, however, high-condition, technically non-relict places may still be valuable to park management. With the restorative passage of time, they could qualify for consideration as research natural areas.

The likelihood and significance of recent recreation posed a second set of considerations. Hikers and backpackers today are surprisingly intrepid, sometimes seeking out remote basins or climable buttes for the seclusion and views they afford. Fortunately, hunting, fishing and off-trail packstock are not relevant thanks to NPS regulations. On balance, we felt that visitation should have very little bearing on relictness, except where campfire-building or clearly abusive practices had occurred.

Our methods were not sophisticated enough to detect impacts on vegetation resulting from regional air pollution or trace-element dry deposition, to say nothing of postulated global warming. Probably no place on earth has escaped such influences, however miniscule. Still, in these generally clean airsheds we saw no reason to disqualify any site because of ambient impacts. We could not document them, but they might be subtly registered in the color slides we took over relocatable ground stations.

Plant Species Identification

Once we affirmed a site's relict character, we first compiled a species list (or the technician began it while the ecologist worked on the writeup). A list had several purposes: supporting the communit typology, informing the "word picture" for the site, and affording a presenc /absence baseline for future investigators. Because we were not charged w th botanical or endangered-species surveys, plant searches were thor ugh but not exhaustive.

We obtained collecting permits before removing even a few specimens. Collecting was kept to the essentials, to minimize i pact. The second author compiled and checked nearly all the plant species li ts that accompany the site writeups below. He identified most plants in t e field, or took specimens (often just foliar parts and flowering str ctures, to avoid uprooting individuals) to camp for use with keys. T e remainder of the specimens were identified during the winter of 1990- 1.

Vouchers reside in the Great Basin Field Offic unless returned to the administering unit as a condition of the collecting ermit. Welsh and others (1987) served as the nomenclatural authority for bot Utah and western Colorado, with very few exceptions.

Our field efforts were spread over eleven unit s. Accordingly, visits could not always coincide with the height of flower ig or even with the appearance of some herbaceous species. Our lists no doubt lack some taxa that appeared, flowered and withered before our late-summ er or fall visits. Conversely, others weren't apparent until after our lay and late April work. However, we believe our lists are functionally compl ete; they always have species whose dominance and constancy help denote th e vegetation type(s) present.

Vegetation Typology

Surveys started with the full classification (Bourgeron and Tuhy 1989) in hand. We often took along a local system for co parison's sake. Dominant-species determinations (Table II.1, page 4) could s metimes be made in advance of field trips. Similarly, we occasionally knew fr n elevation and substrate that a particular overstory dominant would be prese t. The senior author made the final assignment of vegetation types and noted a nomalies.

As mentioned, Table II.1 is a careful condens tion of the full, Plateau-wide system. However, it displays (because of sout western Utah and interior western Colorado units) a good many more types than are present in relict sites of Bryce Capitol Reef, Cedar Breaks, and Zion Relict sites of Capitol Reef harbored types not covered by the classificati n, or partly so. These included bristlecone pine/herbland communities and inyon pine/pygmy sage.

We note such typological amendments and anoma ies in the writeups for the particular sites, and in summary fashion within the Conclusions. We did not amend Table II.1 for lack of corroboration with our types, which may be merely peculiar to the places we encountered them. Anomalies, of course, contribute to study values where they help illumina e the biogeographic themes or paleohistory of the Colorado Plateau (see for ex mple Johnson 1986).

Repeatable Photography at Permanent Stations

At most sites, we installed a photostation and mounted a professional tripod and 35-millimeter camera over it. The color-slide panoramas we took will enable matching of our scenes with those taken years hence by another student of the Plateau's vegetation and terrain. According to Lambert (1981:66), "a pair of matched photographs links a moment in the past with the intervening unseen events, and the new photograph establishes a point on a [photographic] network for future observations of the land." The camera lens records many features that are impossible to map or convey through words, numbers, or sketches.

We thought that making our photography repeatable would permit future detection of shifts vegetation appearance, reveal any selective or accelerated plant mortality, and confirm a lessening in total vegetal or cryptogamic cover. Repeatable landscape photography is highly appropriate for the vast semideserts and woodlands of the northern Plateau. Photographs are especially useful in arid climates and open vegetation, where resource values are often diffuse, vistas are large, and the expense of more detailed inventories is not justifiable" (Rogers, Turner and Lalde 1983:90).

After other survey tasks, we chose the locations of photo stations "subjectively, but without preconceived bias". Local prominences like slickrock turrets and hillocks provided good vantages, which future photographers can readily find. Also, we easily obtained panoramas when the lens could be swung over closely intervening objects. The stations appear as an "X" on the maps accompanying the writeups. We installed from one to three stations per site. Refer to Volume V (Schelz and Van Pelt 1990) for a fuller description of the craft of repeat photography, our methods, and applications of the archived panoramas.

We caution that our photographs, although abundant and widely encompassing of fore- and middle-ground terrain, do not depict the entirety of each relict area. Similarly, the slide collections in Volume V are not a complete "gallery" of all the vegetation types present in Bryce, Cedar Breaks, of Capitol Reef. We neither installed photo stations nor obtained panoramas at the Zion sites.

Nested-Frequency Data Collection

The CA specified the acquisition of quantitative data in conjunction with the narrative surveys. Lacking more explicit direction, we chose to use repeatable photographs. Changes on matched images are potentially quantifiable. Secondarily, we installed permanent transects that, like our photo stations, could be later relocated and re-read. Both photo stations and transect ends are marked with numbered aluminum tags. The frequency transect is usually visible in one of the panorama frames and is thus found close to one of the map "X"s.

The nested-frequency approach of Smith, Bunting and Hironaka (1987) is highly sensitive to real compositional changes in shrubland, grassland, and open woodland communities. It is simple and rapid, involving the placement of 50 nested plots demarcated with a portable wire apparatus. The data obtained from one transect cannot constitute an inferential sample for the relict site as a whole. Rather, they and the marker stakes are simply a benchmark in the most thematic or unusual community present. We often used the data to confirm the vegetation type identification. All transect data are archived in the Great Basin Field Office. Their transcription to this report would have added greatly to its bulk.

Boundary Demarcation

The last field-survey task was a tentative boundary choice. With later modifications as advised by unit staff, these are the heavy lines on the writeup maps of this volume. Unless otherwise explained, the boundaries encompass only the fully relict parts of the survey area. We rarely made and mapped distinctions within a site between relict and less-than-relict vegetation stands.

The tops of buttes and mesas presented the easiest cases, in which we drew the line at the rims in all instances. Elsewhere, the site we delineated was a readily-visualized, natural unit, but with some arbitrariness in places for lack of abrupt topographic bounding. Ridgetops, alcoves and canyons are examples.

If the unit was small and/or quite distinct (typically a butte summit) we usually did not draw a boundary. We thus avoided obscuring features at the map scale used in the narrative sections. A few areas are somewhat diffuse in concept, occupying thousands of acres over which it would be impossible to follow the boundary on the ground. We again refrained from drawing a boundary. In any case, undelineated areas are wholly within non-development park zones, so no line is needed at this stage to assure interim recognition and protection. (The zone, such as "Natural" or "Environmental Protection", of the site is specified in almost all writeups).

We provide acreages only in instances when we could confidently draw a boundary. Our estimates are dot counts, refinable with planimetry. Acreages could thus be determined later, preferably by vegetation type as well as for the full site. This would be pertinent when places are nominated for research natural area status, or for an official change in zone. Thus, any figures we supply are to help readers gauge the extent of pristine conditions or the study resources available. Our estimates are not the final word, nor are they implicit designation or rezoning recommendations.

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BRYCE CANYON NATIONAL PARK UTAH

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BRYCE CANYON NATIONAL PARK

Bryce (BCNP) is located in southwestern Garfield County and northwestern Kane County, south-central Utah. The 20-mile-long unit was proclaimed a national monument in 1923, became Utah National Park in 1924, and received its current name in 1928. Bryce was "set aside primarily for its panoramic views and display of geological features that were created by dynamic natural forces of erosion...The outstanding feature of [BCNP] is the multi-colored amphitheaters of eroded rock beds...cut into the Pausaugunt Plateau. Each of the amphitheaters has a wide variety of carved rock forms resembling miniature cities, cathedrals, spires, and bridges..." (BCNP 1989: 8). Bryce's vegetation was not directly instrumental in the park's establishment, but it has received a good deal of botanical (Buchanan and Graybosch 1981) and ecological (Buchanan 1960; Roberts n.d.) attention over the decades.

Bryce has 35,385 acres and no significant inholdings. The Park Service has recommended about 22,000 acres of Wilderness, but no Congressional action has been taken. The applicable park wilderness plan needs revision, in any case. Generally, park lands below the rim are defacto wilderness, whereas those above are not recommended for Wilderness but are in the Natural Environment Subzone. Newmark (1987) has used Bryce to demonstrate that some national parks may be too small to prevent a gradual but marked decline in the number of vagile species present within the unit. Bryce has experienced such a "faunal relaxation" since early censuses were taken, he claimed.

Over one million visitors (many from Europe) visit Bryce each year. More than 5,500 may be present on a typical summer day. However, only about one-quarter of one percent of visitors embark on backcountry hiking and/or camping. Consequently, an appreciable proportion of the park receives negligible recreational impact despite the whole unit's narrowness.

Buchanan (1960) recounts the park's grazing history from the turn of the century through 1957. Livestock were present in 1918, and the northern reaches of Bryce were not fenced until 1935. Even today, stock driveways traverse the center of the park and cattle trespass is frequently noted. Thus, topographic barriers rather than perimeter fencing must ensure the persistence of relict vegetation sites.

Bryce's appealing plant communities have been classified and characterized in detail (Buchanan 1981; Graybosch and Buchanan 1983; Roberts n.d.; Youngblood and Mauk 1985). Roberts' (n.d.) units exhibit considerable overlap with our classification (Table II.1). Bryce's flora is likewise well-recorded (Buchanan and Graybosch 1981). The second author was integrally involved with mapping, and setting up a monitoring program for, the numerous rare plants found on the "breaks" and occasionally elsewhere.

The park objectives most pertinent to relict vegetation sites and surveys are perhaps (under Natural Resource Management): "To the degree possible, to restore and perpetuate the native plant and animal life and natural evolutionary processes that existed prior to disturbance by European man" and (Data Base Collection) "To secure, through research or other means, adequate information to perpetuate the park's natural resources, preserve its cultural resources, and provide diverse opportunities for environmentally compatible public use of the park" (BCNP 1989: 28).

Reconnaissance work by Tuhy (1988), Schelz (1990) and Van Pelt (1989) disclosed several sites that might harbor relict communities. Two were dropped after further fieldwork. The places described in the following narratives appear to be genuinely pristine, with the exception of North Fairyland Bench. That site unquestionably sustained tree cutting and grazing before the boundary fence was built, but the ensuing 55 years have enabled natural forces to restore the forest and meadows to very good condition.

BOAT MESA

Introduction

The only distinctly isolated site in Bryce Canyon "floats" off the northern rim in the vicinity of Fairyland Point (Map II.1; Figure II.1). Boat Mesa (BM) has high curiosity value, as it is not merely an arm of the Paunsaugunt Plateau at the same elevation. Rather, BM's summit is distinctly higher (Figure I.1), its geology is different, and it supports vegetation quite unlike that of the plateau (Figure II.2). The site's communities receive no mention in previous ecological studies (e.g., Buchanan 1960).

The first author visited BM on September 24, 1989. Schelz completed a plant species list on September 14, 1990 while employed by the park. He also emplaced one photo station on the mesa's far end (Figure II.1; Schelz and Van Pelt 1990; Map II.1). The point appears indistinctly on that map.

Location and Size

Boat Mesa is in southwestern Garfield County, Utah, in the northeastern part of Bryce. The site occupies the divide between Fairyland and Campbell canyons (Map II.1). It is about one and one-third miles east-northeast of the Visitor Center, but cannot be viewed from there or the main road. Boat Mesa stands out quite well on large-scale aerial photographs (BCNP 4-04 and 4-05, 1:12,000, flown June 11, 1987), and from most park viewpoints to the south.

Boat Mesa is about one-tenth mile wide and one-third mile long (roughly 176 by 580 yards). The top consists of about 19 acres (Map II.1).

Accessibility

Boat Mesa is one of the more easily reached relict sites of the northern Plateau survey, but evidently very few visitors take the trouble to climb to the top. The trip from parking areas is neither strenuous nor hazardous. To reach the beginning of the hike, one turns east just south of the main Bryce entrance and proceeds for one mile. The mesa is readily visible, and a 15-minute hike, from the popular Fairyland viewpoint. A sign there says "Boat Mesa 1/2", which is accurate, but a little further along the hiker will encounter no turnoff. In fact, visitor digressions onto the mesa's shoulder (Figure II.1) appear to have been purposely discouraged by brush piles.

The remaining tread goes up through a woodland of Douglas-fir (Pseudotsuga menziesii), pinyon pine (Pinus edulis) and curl-leaf mountain mahogany (Cercocarpus ledifolius). Knowledgeable park staff said that the far end of BM affords "the best view in the park", but this opportunity is not mentioned to the public.

Relict Character

Boat Mesa has sustained no overt historical, pre-park commodity uses such as logging. No written record nor physical sign of livestock grazing could be found. The site is definitely "wilderness", although close to park developments. The Park Service has not placed any facilities or structures on the summit, and does not allow concessionares to use it. Until 1988, however, the park sponsored hikes to the far end. Groups consisted of 10 to 15 visitors, who used a route close to the southern rim. The hike has been discontinued, and today little evidence of it remains. No camping was involved. Boat Mesa appears to be a bonafide relict area. Although not fire-free, it has not burned over. Some trees are hundreds of years old.

Geology and Terrain

The top of BM is mantled with a Tertiary cong omerate (Bowers 1991; Brox 1961). "An unconformity, represented by an erosion l surface, separates the conglomerate from the underlying white beds" (Brox 961: 29). The conglomerate has dark pebbles (mainly of chert) in "white carbonate matrix". This stratum is about 100 feet thick over the Wasat h Formation (Figure II.1; and see Figure 14 in Brox (1961)).

Elevations within the site range from about 8 50 to 8076 feet. Thus, the top stands between 150 and 300 feet higher than nearby places on the Paunsaugunt rim. However, the plant communities ap ear to be more xeric than those of and within the ponderosa forest (Figure II 2; Figures II.7 and II.8 on page 48). Ponderosa pine (Pinus ponderosa) is e tirely absent on BM.

About one-third of the summit consists of gen rally grassy openings. Signs of large disturbances or artificial clearing re absent. The topography is largely level and planar (Figures II.1 and II.2). The only sloping terrain forms a band around the mesa about 50 feet wide, in lined at about 20 degrees.

Vegetation

The main "theme" on BM is a medium-statured G mbel oak (Quercus gambelii) shrubland with successively overtopping m untain mahogany, Utah juniper (Juniperus osteosperma), pinyon pine, and (ocally) Douglas-fir and white fir (Abies concolor). Small and frequent gra sy inclusions chiefly support Elymus salinus (Figure II.2). A fairly mas ive but still typical pinyon-juniper woodland grows closer to the rim (nc pictured). Gambel oak plants do not occur as trees, only in fairly thick o thick mottes. The montane conifers in the area's center are too few t constitute or presage a coniferous forest, except at the very far (southeas) end. Types present appear to be (from or adaptable from Table II.1):

1. **Quercus gambellii Series** (Figure II.2).

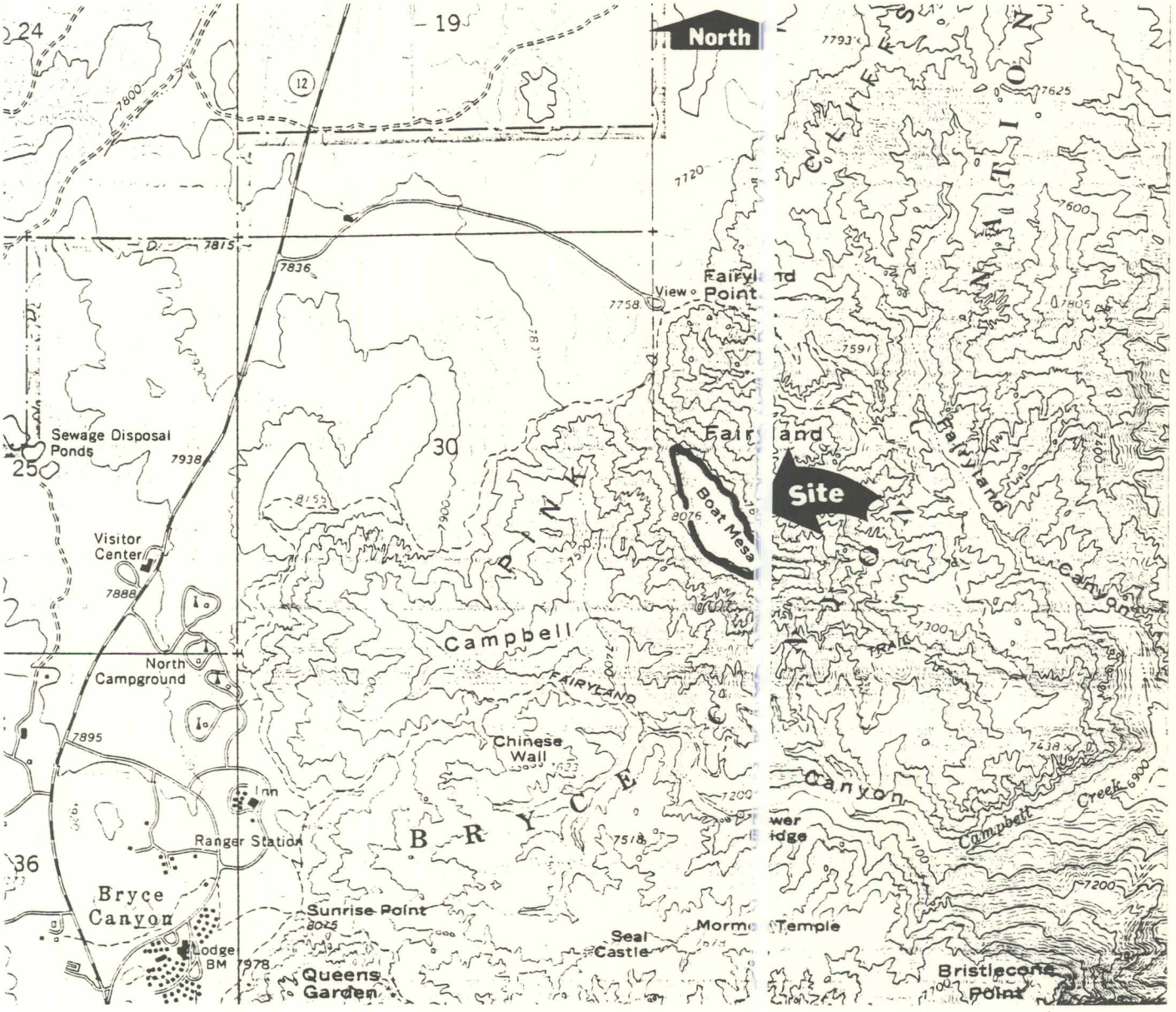
2. **Pinus edulis Series.** (Either Cercocarpu ledifolius or or Elymus salinus may serve as an under tory denominator. Pinyon trees as large as 30 inches diam ter root collar, and juniper to 33 inches d.r.c., are co mon.)

3. **Pseudotsuga menziesii/Cercocarpus ledif lius (PSME/CELE).** (Minor and atypical representation on s utheast end).

Management as a Relict Area/Significance

The site's placement in the (pending) Wilderr ss Subzone is fully appropriate. Primeval conditions should be sustain d. We suggest that the Park Service assess visitation at the end of each h gh-use (May to October) season, and then institute hiking restrictions if n cessary.

Boat Mesa is a park jewel. It is discrete an striking, and there is no place like it in Bryce. Its geology and plant comm nities are anomalous for this context and elevation. The oakbrush/mahogany egetation is more akin to that outside the park, below 7000 feet or so. Also the classification does not squarely account for this close admixture of oa and other woody species--Boat Mesa has neither pure Gambel oak shrubland nor genuine coniferous forest habitat types. Furthermore, a good many plants cha acteristic of nearby ponderosa pine forests are lacking. The site is to small to qualify as a Research Natural Area, but it certainly deserves sp cial care and more study.



Map II.1 Location and boundary of Boat Mesa. Bryce Canyon 7.5′ quadrangle. Photo station shown by "X".

Table II.2 Vascular plant species list for Boat Me a, Bryce Canyon National Park. Taxa observed on Septem er 14, 1990.

Trees

Acer glabrum
Abies concolor
Juniperus osteosperma
Pinus edulis
Pseudotsuga menziesii
Quercus gambelii

Shrubs

Arctostaphylos patula
Ceanothus martinii
Cercocarpus ledifolius
Cercocarpus montanus
Chrysothamnus viscidiflorus
Eriogonum corymbosum
Holodiscus dumosa
Purshia tridentata
Symphoricarpos oreophilus
Tetradymia canescens

Grasses and Grass-Like Plants

Bouteloua gracilis
Elymus salinus
Festuca ovina
Stipa comata
Stipa hymenoides

Forbs and Cacti

Arabis de issa
Aster sp.
Astragalu convallarius
Astragalu kentrophyta
Cirsium a izonicum
Calochort s nuttalli
Calylophu lavendulaefolia
Castille linariifolia
Cryptanth abata
Cryptanth humilis
Eriogonu racemosum
Erigeron umilis ssp. *concin oides*
Euphorbia fendleri
Gilia agg egata
Haplopapp s armeroides
Hymenoxy acaulis
Lucelene ericoides
Macheran iera grindeloides
Oenothera caespitosa
Penstemon leiophyllus
Senecio m ltilobatus



Figure II.1 The northeast side of Boat Mesa. The access trail goes along the skyline from the right (northwest). This partly-shaded slope supports many Douglas-fir, but very few occur on top.



Figure II.2 A Gambel oak/grass stand atop Boat Mesa, with overtopping curl-leaf mountain mahogany and Utah juniper.

BRISTLECONE POINT

Introduction

Relict-area prospects were sought that might best typify the colorful and renowned "breaks" or Bryce Amphitheater terrain of the park. Graybosch and Buchanan (1983) urged the protection of its bristlecone pine (Pinus longaeva) habitats, for two reasons: the exceptional variety of endemic plant species and varieties found there, and the bristlecone's occurrence at unusually low elevations in Bryce. The Claron Formation, with these species, is superbly exposed beneath Sunset, Sunrise and Inspiration Points.

The first author spotted "Bristlecone Point" (BP) from the rim of Boat Mesa, and defined a tentative boundary from that higher vantage (Map II.2). This site seemed to be well-segregated from visitor trafficways, and a likely prospect for finding many if not all of the breaks endemics (Graybosch and Buchanan 1983). Of course, much of the terrain appeared barren or nearly so. He inspected the site on September 26, 1989. Schelz installed a photopoint and compiled a plant list (Schelz and Van Pelt 1990; Table II.3 this volume).

The area contains two major wooded expressions (Figures II.3 and II.4). It is surely one of the most beautiful places in the park. Solitude is easily gained, as visitors hardly ever venture east of Morman Point. Also, the area is more or less defended by cliffs on its north, east and south sides. Of all the southern Utah relict sites of the survey, Bristlecone Point most readily bears comparison with an existing Research Natural Area. That is the Red Canyon RNA, which The Nature Conservancy helped establish on the Dixie National Forest. The RNA is about 13 miles to the northwest of BP.

Location and Size

Bristlecone Point is situated in southwestern Garfield County, Utah, in the east-central sector of Bryce Canyon NP. The site is below and about one-half mile directly east of Sunrise Point. It takes up the north side of the Bryce Canyon Amphitheater, and lies between Bryce and Campbell Canyons. The working boundary follows topography well on all sides but the west. (The hatching on Map II.2 covers additional, inaccessible acreage).

The demarcated area is a little less than one mile long and about four-tenths mile wide. Its size is (cross-hatching not included) about 177 acres.

Accessibility

The quickest way to reach the area is to descend on the signed, maintained trail from Sunset Point into Campbell Canyon and then to proceed nearly to Tower Bridge. About 600 paces updrainage from Tower Bridge, an unnamed wash intersects the trail. Going up the wash (which constitutes the provisional western boundary) puts the visitor onto the area's periphery. Travel throughout the area is unobstructed (Figures II.3 and II.4), but it can be somewhat taxing in summer because there is little shade and a deceptive amount of up-and-down walking. The Park Service does not "advertise" this trailless area, nor have hikers created any trails of their own. The terrain is a little too adverse for horseback travel, and vehicles are prohibited.

Relict Character

The area lacks signs of historic or modern occupancy and land use. It is devoid of economic resources and shows virtually no sign of visitation (the experiences and vistas it offers are obtainable elsewhere, closer to trails).

No administrative structures are present. We feel safe in concluding that the area's "forests" are pristine, and that its barrens and undergrowth vegetation have not been affected by livestock in many years (if ever).

Geology and Terrain

According to Graybosch and Buchanan (1983: 701-702), "the Claron limestone, a Tertiary deposit, is divisible into Red Eocene beds and White Oligocene beds, which differ somewhat in presence or absence of pigmentation in the form of iron and manganese oxides, and in amounts of sand and conglomerates in the limestone. The...formation [has] a rapid rate of erosion, largely a function of creek resulting from winter freeze-thaw activity and washaway by thunderstorm runoff...Soil development is limited." According to Bowers (1991), the area only exhibits the red (or pink) upper member, which has "thin to thick-bedded limestone, argillaceous limestone, and dolomitic limestone with sparse, thin interbeds of calcareous mudstone".

Although the area displays all the variegation (diverse coloration) so typical of Bryce, it basically lacks "carved rock forms resembling miniature cities, cathedrals, spires, and bridges..." (BCNP 1989: 8). This is not the scenic and geomorphologic core of the park, but rather an upland of rounded forms (Figures II.3 and II.4). Elevations range from about 7250 to 7787 feet. Perhaps the only unusual terrain feature is a curious sinkhole north of Bristlecone Point. Its accessible floor harbors forestlike ponderosa pine.

Vegetation

Graybosch and Buchanan (1983; "GB") were the first authorities to define the "vegetative [sic] types" of the Bryce amphitheaters, so their scheme receives attention here. It overlaps a good deal with our classification (Table II.1). Series and associations present appear to be:

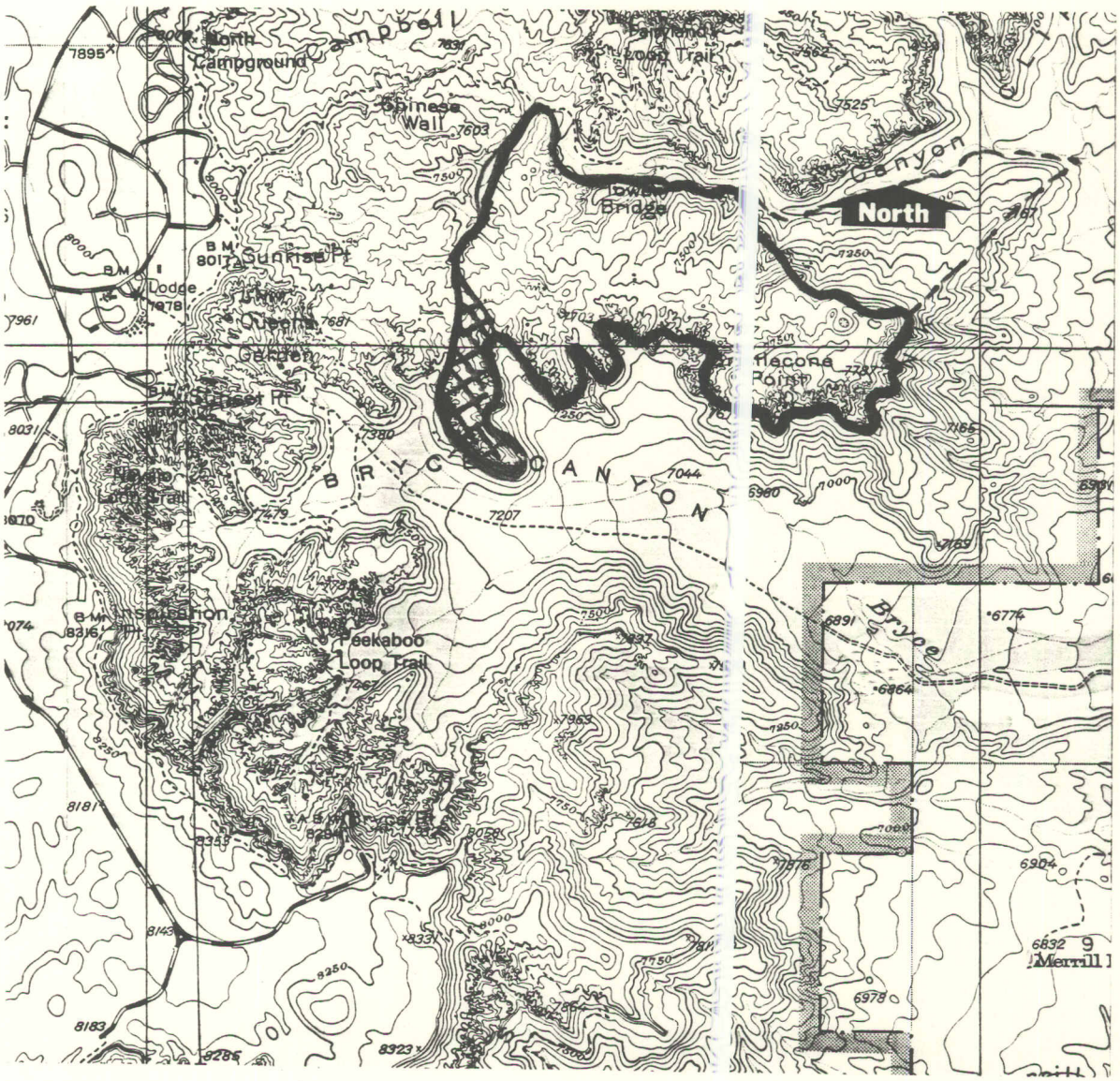
1. **Pinus flexilis/Pinus longaeva Series.** (No specific associations have been identified, according to Youngblood and Mauk (1985). The unit of GB is the Pinus longaeva type. See Figure II.3).

2. **Pinus ponderosa/Arctostaphylos patula (PIPO/ARPA).** (The unit of GB is the same. See Figure II.4).

Types identified by GB that are not present include: PIPO/ARPA, Cercocarpus montanus phase; Pseudotsuga menziesii/Pinus ponderosa; mixed coniferous type, Picea pungens phase. However, "washes, clay and talus" abounds (Figure II.4). Representation of the endemic plants (some of them having widespread distributions in southwestern Utah, however) is very good (Table II.3, right column). Two absent taxa are Cymopterus minimus (Umbelliferae) and Pediomelum pariense (Leguminosae). The "rare plant list" has four more taxa than does the list for the Red Canyon RNA. The RNA has twice the acreage.

Management as a Relict Area/Regional Significance

Bristlecone Point appears to be fully sustainable as a relict vegetation site, even with the high and increasing numbers of visitors. However (as was once proposed) no trails should be constructed to or toward Bristlecone Point. Rare-plant management strategies formulated for the park will be applicable here, as will monitoring procedures. The area is locally significant, as part of the Bryce scenic complex. However, its terrain and plant life are not fully encompassing of the under-rim environment, and there is already a highly similar RNA in the region. We nonetheless commend Bristlecone Point as genuinely pristine and a top-flight rare-plant refugium.



Map II.2 Location and boundary of Bristlecone Point. Bryce Canyon and Bryce Point 7.5′ quadrangles.

Table II.3 Vascular plant species list for P·istlecone Point, Bryce Canyon National Park. Observatio·s made on September 11, 1990.

Trees

Juniperus osteosperma
Pinus edulis
Pinus flexilis
Pinus longaeva
Pinus ponderosa
Pseudotsuga menziesii

Shrubs

Arctostaphylos patula
Ceanothus martinii
Cercocarpus montana
Holodiscus dumosa
Juniperus communis
Potentilla fruticosa
Purshia mexicana
Purshia tridentata
Shepherdia rotundifolia

Grasses & Grass-Like Plants

Elymus salinas
Festuca ovina
Stipa comata
Stipa hymenoides

Forbs and Cacti

Aq·ilegia scopulorum
Ar·aria fendleri
As·ragalus kentrophyta
Ca·ylophus lavendulafolia
Ca·tilleja linariifolia
Ca·tilleja parvula var. *revealii*
Ci·sium arizonicum
Ci·sium calcarum var. *pulchellum*
Cr·ptantha capitatum
Cr·ptantha ochroleuca
Cy·opterus purpureus
Dr·ba subalpina
Er·ogonum aretioides
Er·ogonum panguicense
Eu·horbia brachycera
Ge·anium richardsonii
Ha·lopappas armeroides
He·erotheca jonesii
Hy·enopappus filifolius
Hy·enoxys acaulis
Iv·esia sabulosa
Le·squerella rubicundula
L·ium perenne
L·thispermum multiflorum
L·natium minimum
M·cheranthera grindeloides
M·honia repens
M·nardella odoratissima
O·nothera caespitosa
O·ytropis jonesii
P·dicularis centranthera
P·nstemon bracteatus
P·tradoria pumila
P·ysaria chambersii
P·lox hoodii
S·lene petersonii
S·ertia radiata
T·nacetum vulgare
T·wnsendia montana var. *minima*
Z·rgadenus elegans

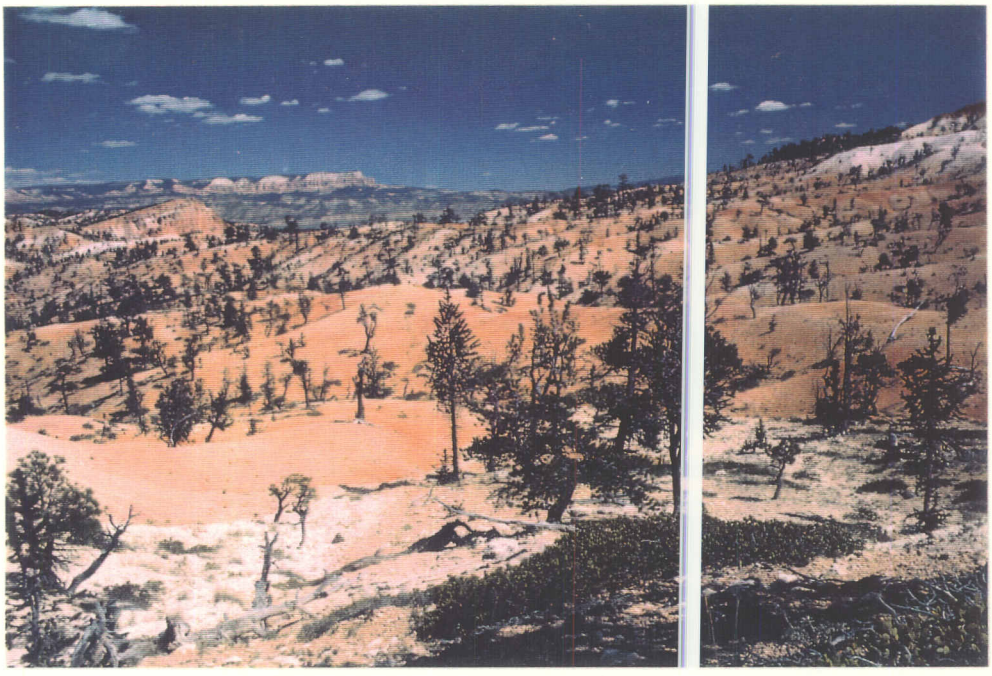


Figure II.3 The bristlecone pine woodland occupying the central part of the site. The view is to the northeast, with Powell Point at the southern end of the Escalante Mountains appearing in the upper left.



Figure II.4 A pocket or stringer of ponderosa pine/greenleaf manzanita surrounded by bristlecone barrens. The rim of the Bryce Canyon breaks lies in the background, near Sunset Point.

MUD/NOON CANYON

Introduction

A rugged, nameless area well south of the Bryc amphitheaters was suggested by Therese Johnson (Resource Management Sp cialist) and Jay Fredericks (Seasonal Ranger). Jay had descended the area's central ridgeline, noting unusually large specimens of pinyon pine and Utah juniper. "Mud/Noon Canyon" (MNC) has neither the gentle terrain of the Paunsaugunt Plateau top, nor any of the "breaks" landscape. The area consist of the upper reaches of two rugged, tangled canyons (Map II.3), two interven ng ridgelines (Figures II.5 and II.6), and the heavily wooded or "shale ba en" slopes beneath three named prominences: Mud Canyon, Noon Canyon and Swamp Canyon buttes.

Mud/Noon Canyon is situated within the narrowe st part of the park, between Yovimpa and Rainbow Points on the south and the main overlooks to the north. The area is thus removed from and below visi tor and administrative byways. Its discovery was a pleasant surprise--MNC is a diversified, steep, out-of-the-way place without discernible human impac ts, well-defended from intrusions by topography and boundary fence section .

Schelz and Van Pelt inspected MNC on Septembe 28, 1989. Schelz returned the following September to complete a plant list (Table II.4) from the accessible parts of the area and to install one photo station (Figures II.5 and II.6; and Schelz and Van Pelt 1990).

Location and Size

Mud/Noon Canyon is in northwest-central Kane ounty, Utah. The area lies on the eastern side of the southern one-third f Bryce. It abuts the park boundary on about half of its perimeter (Map I .3), and it is sandwiched between the plateau top and a lobe of the Dixie Nat onal Forest that extends partway up the east side of the park. Mud/Noon Can on extends for about 0.9 miles east and west, and for about 1.7 miles north nd south. The working boundary (Map II.3) contains roughly 634 acres.

Accessibility

Directions here refer to reaching the area fr m the east (through Tropic), rather than via the Under-the-Rim Trail. We took the long way in, driving and walking, but the route was straightforw rd and could be repeated with a reliable map and by following the signs into the Sheep Creek drainage (to which Mud and Noon Canyons are tributaries). L eaving Tropic, we went via Cannonville and the Kodachrome Basin road. A good dirt road goes toward then into Sheep Creek, and there are short stretches in the dry creekbed.

Our parking place was about 1.5 miles east of the park boundary, and less than one-half mile inside the (signed) Dixie N tional Forest boundary. (The parking location would fall in the center of t e right margin of Map II.3). We ascended the right (north) branch of Noo n Canyon, turned east on the main ridge to our photopoint (Map II.3), and de scended northward into Mud Canyon. Most of the area is quite thickly wooded a d could not be traversed without continuous bushwhacking. Mud/Noon Canyon l acks good helispots, so helicopters are not a feasible option.

Relict Character

Given the pervasiveness of cattle grazing on national forest land to the east, the main threat to relict character has been livestock. Steep and

brushy as the area may be, it still has no absolute topographic barriers on the east side. However, any past grazing probably occurred only on the fringes and before this section of boundary fence was constructed. Currently, sign of cattle ceases well east of the cross-canyon winging fences at the boundary. The terraces alongside the incised canyon bottoms are so dense that they are fine barriers to cattle, anyhow. The esources of MCN--essentially low-quality timber and fuelwood or fence osts--show no signs of exploitation, nor have they ever been close enough t settlements or sufficiently concentrated to draw attention. The ar a lacks park developments like roads, trails, campgrounds or cabins.

Geology and Terrain

The upper part of the Straight Cliffs Formatio (crossbedded sandstone, and fine-grained sandstone with interbedded mudstone is widely exposed on the ridgetops and sideslopes. The aforementioned buttes are made up the pink member of the Claron Formation, subtended by narrow utcrops of the Wahweap Formation. Canyonbottoms are covered with Quaternar alluvium.
The buttes form an arc that visually defines the are 's western "wall" (Figure II.5). Thus encircled, the area is not easily viewe l or reached directly from above. Except for ridgetops, MNC has very little le el and/or open terrain (Figures II.5 and II.6). Elevations range from 7200 to 8423 feet. About 1200 feet of vertical relief occurs within one-half mile, from the channel of Noon Canyon to the summit of Noon Canyon Butte.

Vegetation

Table II.4 presents some of the area's plant s ecies. The list is incomplete because of the season of observations and the inaccessibility of much of the habitats. Just a couple of the so-calle l "breaks" endemics are present. All of Bryce's coniferous tree species gro here, evidently.

The vegetation types of the area are difficul to summarize readily without excessive coarseness of definition or by at tributing more extent to the "clear" types than they warrant. Mud/Noon Canyo n is well-vegetated with well-developed, undisturbed woodlands and forests, w ith these denotative woody species: Douglas-fir, ponderosa pine, pinyon, Utah j uniper, birchleaf mountain mahogany (Cercocarpus montanus), curl-leaf mountain mahogany, and Gambel oak. Two other subordinate species, on near-barrens and r idgetops respectively, are corymb buckwheat (Eriogonum corymbosum) and greenle f manzanita (Arctostaphylos patula). Distributions of all thes hallmark species intergrade, as is common on transitional foothills w ith contrasting slope aspects and deep canyons. The clear types evidentl present are:

1. **Pinus ponderosa/Arctostaphylos patula (P PO/ARPA).**

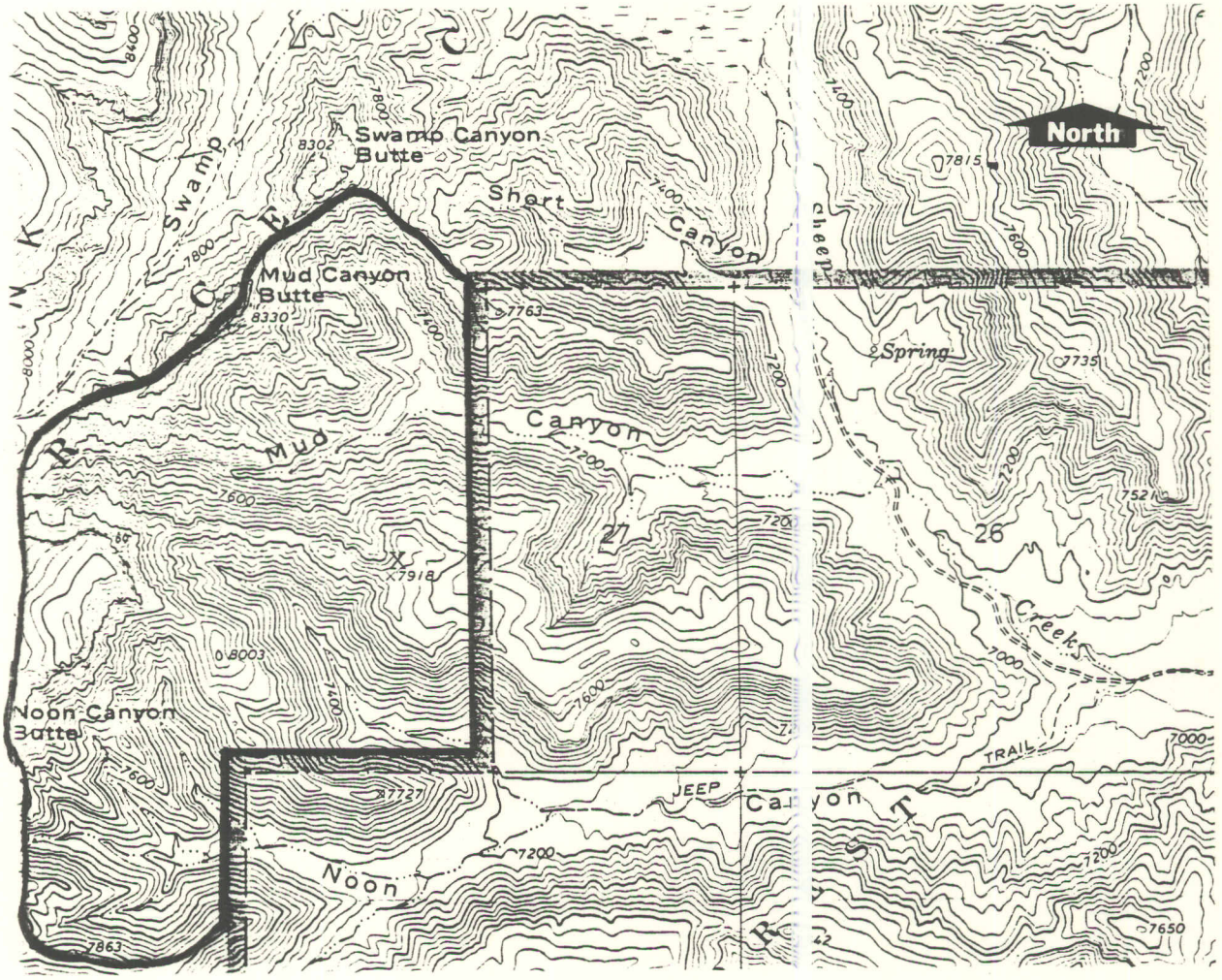
2. **Pinus edulis/Cercocarpus montanus (PIED/ CEMO).**

3. **Pseudotsuga menziesii/Cercocarpus ledif lius (PSME/CELE).**

4. **Atriplex corrugata Shale Barren** (Howeve , denoted here by corymb buckwheat and Elymus salina.)

Management as a Relict Area/Significance

The area lacks any of the special features fo which Bryce is known, and has no known fragile or publicity-sensitive resourc s. It certainly belongs in an eventual wilderness, so the current subzoning is fully appropriate. No particular management measures appear to be necessa y, nor does RNA status.



Map II.3 Location and boundary of Mud/Noon Canyon. Bryce Point 7.5' quadrangle.
Photopoint shown by "X", next to point 7918.

Table II.4 Vascular plant species list for M[illegible]d/Noon Canyon, Bryce Canyon National Park. Taxa obse[illegible]red on September 15, 1990.

Trees

Acer glabrum
Abies concolor
Juniperus osteosperma
Pinus edulis
Pinus longaeva
Pinus ponderosa
Pseudotsuga menziesii
Quercus gambelii

Shrubs

Amelancher utahensis
Arctostaphylos patula
Ceanothus martinii
Cercocarpus ledifolius
Cercocarpus montana
Chrysothamnus parryii
Eriogonum corymbosum
Holodiscus dumosa
Purshia tridentata
Symphoricarpus oreophilus
Tetradymia canescens

Grasses & Grass-Like Plants

Elymus salinus
Festuca ovina
Stipa hymenoides

Forbs and Cacti

Ar[illegible]bis demissa
Ast[illegible]er occidentalis
Ast[illegible]er spp.
Ci[illegible]sium arizonicum
Ca[illegible]ylophus lavendulafolia
Cr[illegible]ptantha abata
Cy[illegible]opterus purpureus
Hy[illegible]enoxys acaulis
Hy[illegible]enopappas filifolius
Iv[illegible]sia sabulosa
Le[illegible]querella rubicundula
Ma[illegible]heranthera grindeloides
Pa[illegible]hystima myrsinites
Pe[illegible]stemon cyanocaulis
Se[illegible]ecio multilobatus
Sc[illegible]idago sparsiflora
Ta[illegible]acetum vulgare



Figure II.5 Photopoint locale on the ridge dividing Mud and Noon canyons. Greenleaf manzanita and Utah serviceberry make up the understory shrubbery.



Figure II.6 The sole photopoint established on the site. The ponderosa pine/greenleaf manzanita type intergrades with well-developed pinyon-juniper woodland, as shown by the Utah juniper in the upper right.

NORTH FAIRYLAND BENCH

Introduction

This Paunsaugunt Plateau site was first identified by J. Tuhy in conjunction with park staff. These surveyors' first impression was one of skepticism--early-day uses must have affected Fairyland Bench before Bryce was fenced. Nonetheless, there is a perennial, multi-agency need to identify little-disturbed examples of "commercial" ponderosa pine forests in Utah.

Schelz and Van Pelt inspected "North Fairyland Bench" or NFLB (Map II.4; Figures II.7 and II.8) on September, 24, 1989. Somewhat arbitrarily chosen, the area is defined by the Pink Cliffs on the east, the park boundary fence on the north and west, and by an imaginary east-west line on the south. We concurred that NFLB was not relict, but felt that it could be written up as a high-condition special case. Detractors from relict condition do not affect the visible scene (Figures II.7 and II.8). Also, high and unnatural fuel loadings characteristic of much Bryce forestland (Buchanan 1981) are absent.

Buchanan's transects 9, 10 and 11, which he read in the late 1950's for a doctoral dissertation project (Buchanan 1960), cross the area before terminating near the north fence. Newer data from the plots were not available at this writing, but a "re-read" was being planned.

Location and Size

North Fairyland Bench is situated in southwestern Garfield County, Utah. The area's northwestern corner is one mile southeast of Rubys Inn (off Map II.4) at the park's main entrance. The center of NFLB is 2 miles northeast of the Visitor Center (Map II.4), but cannot be viewed from there. The area is less than one-half mile north of the developed Fairland Point viewpoint.

North Fairyland Bench extends for one-half mile north and south, and for a little over one-half mile east and west. The boundary shown on Map II.4 contains about 136 acres, so the rough equivalent of a quarter-section is involved.

Accessibility

The area is about a 15-minute walk from the viewpoint, which is easily reached (almost year-round) in any type of vehicle. An alternative means of access is the little-used service road that leaves the main highway just below the "North" arrow on Map II.4. The road swings by NFLB's northwest corner. Along that stretch, the visitor need only cross through the barbed-wire fence. The interior of the area has no roads or trails, but walking (or snowshoeing and cross-country skiing) are easy and rarely impeded (Figure II.7). Although it is close to park traffic, NFLB is obscure to both NPS employees and the general public. No visitors were seen during our inspections of the area, and no camping is allowed.

Relict Character

The impact of human uses before and somewhat after Bryce Canyon NP was established is not in question. Ponderosa pine stumps attest to this, as does the complete absence of topographic barriers to domestic livestock. Low and now quite subdued check dams were built in watercourses to arrest gullying and headcutting. The dams were successful, but evidence of them has not fully disappeared. Also, the Park Service felled (but did not buck or remove) a good many living ponderosa pine trees for mistletoe control.

Fortunately, logging was not heavy or selecti e enough to have taken all the large trees. These now comprise the fairly abu iant snags (Figure II.7, skyline) and patriarchs of the forest. Mature tree are plentiful, too (Figure II.8). The area is now essentially restock i with trees of all sizes, and logging slash has "melted down". All stumps ar low to the ground.

Despite some infrequent cattle and horseback-t our trespasses, the area currently has no depleted areas, exotic plant speci s, or concentrations of manure. We saw no signs of visitors, such as trash or makeshift campsites.

Geology and Terrain

North Fairyland Bench is underlain by the upp r member of the Claron Formation (Bowers 1991). The intermittent drainage ays have well-vegetated Quaternary alluvium (clay, silt, sand and perhaps g avel). No rock outcrops or "breaks" terrain are expressed. The topography s almost uniformly planar (Figures II.7 and II.8), and the whole area has les than 100 feet of relief.

Vegetation

The major association (habitat type) present s:

1. **Pinus ponderosa/Purshia tridentata (PIP /PUTR)** (Table II.1; and see page 52 in Youngblood and Mauk 1985). The habitat type here is mildly transitional to Pin s ponderosa/ Artemisia nova, as A. nova is prominent in openings, and that h.t. occurs over large areas north of Bryce).

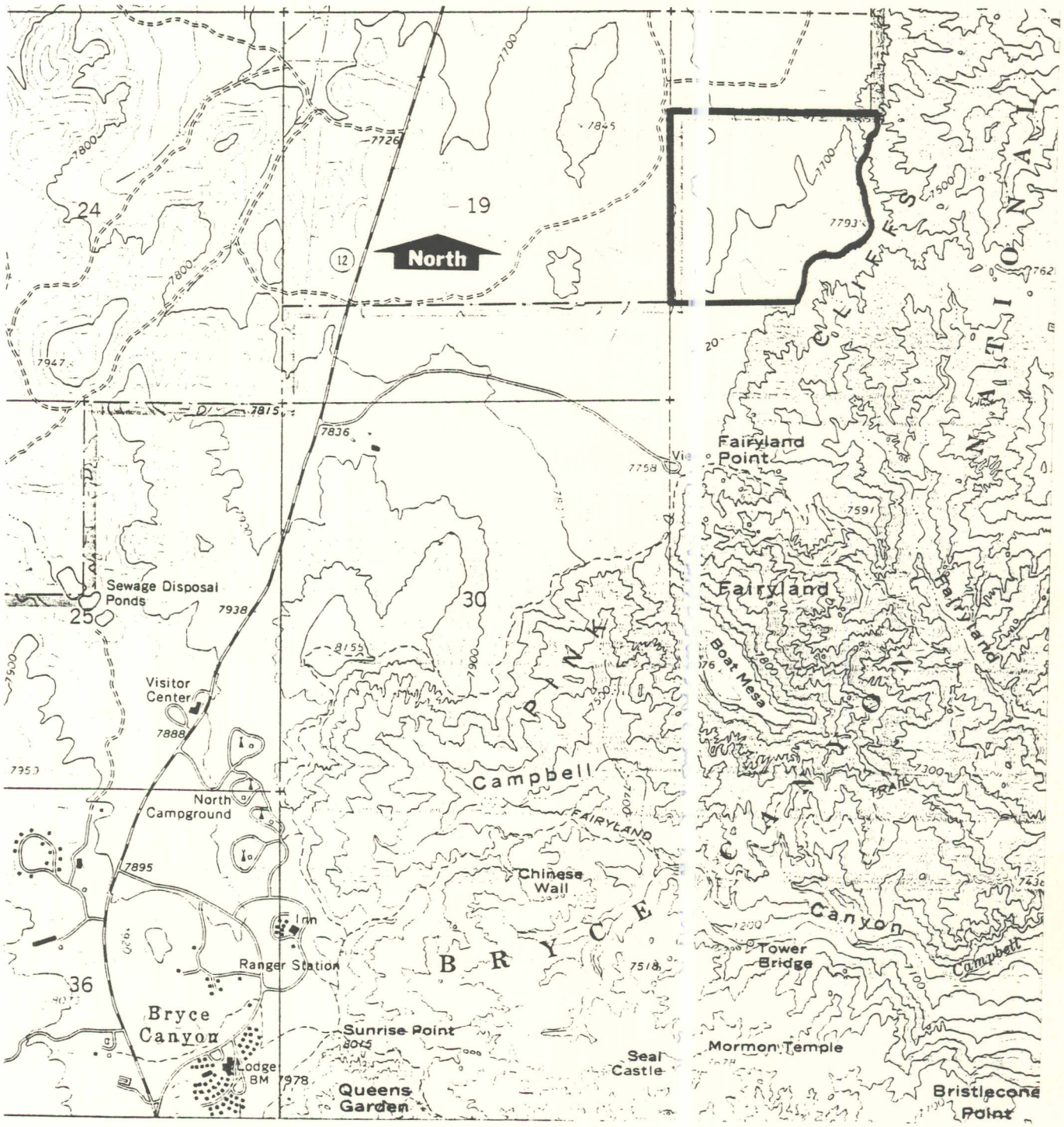
Roberts (n.d.) supplies a "Key to Community Types i Bryce Canyon". Basal area and "indicator species" must be determined aft r the habitat type is identified. The key points to a JUSC (Juniperus sc pulorum; Rocky Mountain juniper) c.t., but the value of this determination eems unclear. Youngblood and Mauk (1985) do not recognize a phase of PIPO/PU R. The meadows were not ascribed to a unit in the classification, but a Car x series in the "Desert and Montane Grasslands" is probably appropriate.

The ponderosa pine forest has an uneven-aged, multistory structure. Trees dating back to a particular recruitment episc e comprise small groups (Figure II.8). Using 40 variable-radius plots, por erosa pine basal area was estimated to be 64 square feet per acre. Canopy cc erage of Rocky Mountain juniper is about one percent. Total heights of the dominant ponderosa pines range from about 59 to 85 feet (Figure II.8), for a estimated average of 70.5 feet (n=15). An Abney level was used for height me surements.

Management as a Relict Area/Regional Significance

Because NFLB is no longer genuinely relict, m asures should instead be taken to prompt or allow its return to a more natur l condition--as largely gauged by forest restocking and native species comp sition in the meadows. Buchanan's (1960) plots are probably the best if no the only baseline for assessing whether the area is becoming more "natura ", however interpreted. No interventionist actions, such as tree planting, eem necessary or justifiable. In sum, natural succession should be llowed to continue its slow and steady course.

North Fairyland Bench has no particular curre ncy or value as a potential addition to the regional RNA system. It would not qualify under current NPS directives, but it might some decades hence. In th e meantime, prospects are good for locating a never-disturbed site on the Dix e National Forest.



Map II.4 Location and boundary of North Fairyland Bench. Bryce Canyon 7.5' quadrangle.



Figure II.7 A typical opening in the ponderosa forest. This one is not a result of logging. The uneven-aged, multistory character of the forest is clearly evident here. A Rocky Mountain juniper appears in the lower right.



Figure II.8 The forest interior, with three trees typical of the largest size class present.

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CAPITOL REEF NATIONAL PARK, UTAH

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CAPITOL REEF NATIONAL PARK

Capitol Reef (CRNP or CARE) is very long and generally narrow (2 to 14 miles). It contains 241,904 acres in parts of Wayne, Garfield, Sevier and Emery counties, in south-central Utah. Most of the park's acreage extends north and south completely across west-central Wayne County and east-central Garfield County. Capitol Reef adjoins Glen Canyon National Recreation Area (Tuhy and MacMahon 1988) at the park's south end, and the Fishlake National Forest on its west and northwest sides. Other surrounding lands are administered by the Bureau of Land Management and the State of Utah.

Capitol Reef became a park in 1971. The precursor Monument was proclaimed in 1937, with about 37,000 acres. The main purpose of the unit has been, and remains, the protection and display of about 70 miles of the 100-mile-long Waterpocket Fold. The "Reef" section of the Fold is an unsurpassed example of an intricately eroded and spectacularly colorful, monoclinal flexure (CRNP 1984). The park has significant additional geologic, scenic and biotic resources in places like Cathedral Valley. Capitol Reef has three administrative districts: Headquarters (Fremont River), South (Strike Valley) and North (Cathedral Valley). The Park Service has recommended that about 90% of the park be classified as Wilderness, but Congress has not taken action on the proposal.

Capitol Reef's "natural history themes" for the Colorado Plateau include "sculpture of the land, geologic history, rivers and streams, desert, and dry coniferous forest and woodland" (CRNP 1984: 2). Rock strata exposed range from the Permian Cutler Formation through Cretaceous Mancos Shale, thus depicting roughly 150 million years of deposition, erosion, and crustal deformation. Almost everywhere, the desert and semidesert vegetation is but a thin, inconspicuous veneer on vast sheets of slickrock and clayey barrens.

Under a contract with the NPS Research Center in Wyoming, Dr. Kenneth Heil (San Juan College, New Mexico) and associates have documented the flora and vegetation of the park. They submitted a draft final report in July 1991. Although a revision was requested by CARE staff, the plant communities and phases in Appendix 4 (Heil, Porter, Fleming and Romme 1991) are used to supplement the site writeups below. These authors' main categories are the following, with an example of a community or community phase also shown:

Badlands Communities
  Hopsage badlands

Grassland Communities
  Eolian grassland

Upland Shrub Communities
  Blackbrush-rabbitbrush

Intermittent Riparian Shrub Communities
  Greasewood-rabbitbrush phase

Pinyon-Juniper Woodland Communities
  Pinyon-juniper-pygmy sage phase

Upland Forest and Woodland Communities
  Bristlecone pine-cushion plant

Riparian and Wetland Communities
  Dogwood-spruce riparian woodland

Not all of the community classes, much less the individual community types and phases, are represented in the relict sites that were surveyed in 1990 and are described below (pages 51-90).

The human influence that has most diminished the acreage of relict vegetation in CRNP is livestock grazing--historic and continuing. Impacts of sheep, cattle and saddle horses were probably severe (and little-regulated) before the Monument was proclaimed; the extent of vegetation alteration was likely to have been only limited by topography. In 1982, after the unit was upgraded to park status and enlarged, a law extended current grazing privileges to the end of 1994 and specified a study of grazing impacts. Those have long been a point of contention between park managers (and conservationists) and the local ranching industry.

Regardless of the eventual disposition of grazing (some lessees have already been bought out, especially in the greater Fruita area), livestock have eliminated relict-site possibilities over large acreages. Examples are the upland shrublands adjoining the Waterpocket Fold west of the Notom Road and Sandy Creek, practically all of Upper Cathedral Valley, and the Hartnet country. Very little of the park boundary is fenced. Impacts within the Waterpocket Fold landmass itself are more localized (or speculative), but signs of livestock were detected in such seemingly secluded places as North Coleman Canyon.

Park management objectives (CRNP 1984: 25) pertinent to relict vegetation, if sites can be found and documented, would include but are not limited to:

> [V.(A)] Through research, secure an adequate data base and in-depth understanding of the park's cultural and natural resources in order to chart credible, long-range management actions to insure resource protection and perpetuation.
>
> [V.(B)] ...prepare and implement practical, short term operating plans to catalog, protect, and interpret park resources on the basis of the best available information.

Prospective survey sites were identified through conversations with park staff (chiefly S. Borthwick and N. Henderson), the fourth author's knowledge of out-of-the-way sites, and inspection of topographic maps. In addition, Bill Romme suggested Upper Deep Creek. "Cohab Canyon Flats", a non-relict/high-condition special case, was handled on an ad hoc basis when the surveyors were in the Fruita area with some time on their hands.

The surveyed areas (seven in all) occur within the Wilderness, Natural Environment, Historic, and Private Development zones or subzones (CRNP 1984: foldout map). (The Development subzone corresponds to state trust land enclaves). The management zoning is noted toward the end of each writeup below. No survey area has been explicitly set apart by current zoning, such as "Outstanding Natural Feature", or through a special park designation like Research Natural Area.

On balance, the community classes listed above are poorly represented within the surveyed sites. If the scale of a future investigation were shifted sharply downward, places of a hectare (about 2.5 acres) or less might be identified that are in relict condition. Such refugia would harbor remnants of the more spatially restricted and/or grazing-sensitive plant communities. Some mesa-top situations are also present, for example in the Golden Throne area, but a helicopter would be needed to reach them.

7176 MESA

Introduction

A small mesa in the Upper Cathedral Valley area was noticed on the Solomons Temple quadrangle (Map II.5). We named the place after its highest point on the quad, 7176 (feet ASL). Unvisited by current park staff, 7176 Mesa ("7M") is the most sharply bounded relict prospect in CRNP. Above an encircling, almost unscalable caprock lies an open pinyon-juniper woodland with an abundance of understory shrubs, grasses and forbs (Table II.7; Figures II.9 and II.10). The site typifies a woodland association not recognized in our classification (Table II.1), but considered very rare by Heil and others (1991). The appearance of the woodland and the terrain is rather unusual.

Schelz and Van Pelt visited 7M on May 29, 1990. We emplaced a permanent photo station on the mesa's west side (Map II.5; Schelz and Van Pelt 1990), compiled a plant list (Table II.7), and extended a nested-frequency transect westward from the photopoint nadir. We spent about 4.5 hours on top.

Location and Size

7176 Mesa is situated at the northern extremity of CRNP, in the tiny sector that lies in far southeastern Sevier County (Map II.5). The mesa is less than one mile from the park's northern boundary. 7176 Mesa may be considered an "island" lying off the "mainland" of Jones Bench (Map II.5, upper left), which is connected to the Fishlake National Forest and ultimately to the Thousand Lake Mountain landmass.

The summit of 7176 Mesa extends about one-half mile east and west, and a little over a quarter-mile north and south. It occupies about 48 acres.

Accessibility

The mesa stands just north of Cathedral Valley Junction, which is readily reached on long, dirt park and public-land roads. The junction appears on maps for public distribution, including that in the handout brochure available at the Visitor Center (the mesa is not shown, however). From the eastern boundary of the park on Highway 24, cumulative mileages are as follows on 24 and the Cathedral Valley Road:

Turnoff right near Caineville:	10.2
Enter CRNP:	31.0
Park on road shoulder in sight of mesa:	36.9

The total road distance from the Visitor Center to the "trailhead" is about 45 miles. We recommend taking plenty of water and gasoline. An alternative route goes north from Highway 24 through the Bentonite Hills and past Upper Cathedral Valley Overlook before descending to the valley.

The ascent of 7M requires about 2.5 hours. It is necessary to go well west (off Map II.5) before ascending Jones Bench and following the saddle from there to 7M's west tip (Figure II.9). Apparently no other route to the top is feasible. Walking over the mesa's surface is easy and pleasant (Figure II.10). About 1.5 hours are needed for the full descent to the valley.

Relict Character

7176 Mesa's summit is unquestionably in pristine condition. We saw no signs of humanity, nor any evidence of catastrophic natural events.

Geology and Terrain

The shallow, limy soils of the summit are derived from the Salt Wash Sandstone Member of the Jurassic Morrison Formation. Under the short caprock, the Summerville Formation makes up most of 7M's mass (Figure II.9). Although it seems lower, the mesa rises over 900 feet above Cathedral Valley.

The summit's topography is largely planar or mildly convex, with no gullies or incisions in the unmarred surface (Figure II.10). The surfaces here appear to be well-stabilized. Mounded microrelief about tree trunks is lacking, which shows that insubstantial deflation or aeolian deposition has occurred. Sandy areas and deeper soils are absent. Microphytic crusts (West 1990) are moderately well-developed and occur only on the sides of wash bottoms. The top is by no means flat or lacking in microterrain situations.

The vertical relief over the summit is 100 feet or less. One intermittent drainageway courses to the mesa's northeastern side.

The site seems to be distinctly dry for its elevation. This may arise from one or both of two circumstances: the permeable soils and 7M's position in the eastern rainshadow of some of the highest terrain on the Utah High Plateaus, athwart the southwesterly storm tracks.

Vegetation

We encountered 41 plant taxa (Table II.7), for an average of roughly one species or variety per acre. Non-native species were apparently absent.

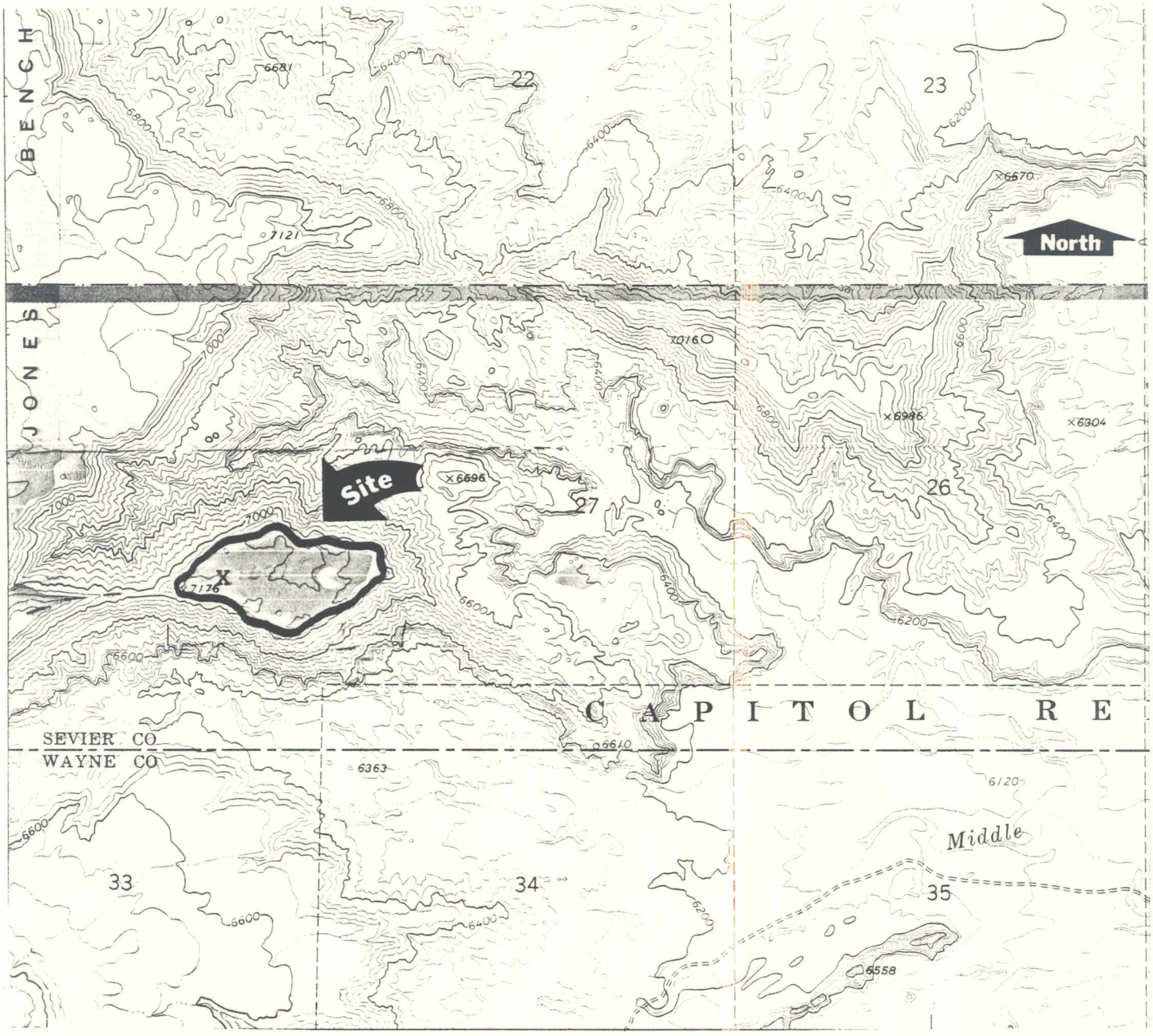
The vegetation's structure consists of about equal proportions of pinyon and Utah juniper, a Shepherdia stratum shared with less abundant Purshia, and (with high constancy) one or more of: Artemisia pygmaea, Phlox austromontana, and Haplopappus armerioides. The presence of A. pygmaea is the most singular and distinguishing feature of this "rare" woodland association. Shepherdia is by far the most noticeable plant under the trees. The typology is:

1. **PINUS EDULIS Series** (Table II.1, page 15. No tabled association is appropriate, so we suggest a Pinus edulis/Artemisia pygmaea type as an amendment to the classification. That would crosswalk with Heil and others' (1991) "pinyon-juniper-pygmy sage phase".)

Differences among trees are chiefly in height and height:crown width ratio. There appears to be an inverse topography-to-tree height relationship; the higher and more exposed surfaces have shorter trees. We thought that 7M's woodland was less dense and shorter in mean height than the stands on Jones Bench, which grow at essentially the same elevation on identical substrates. Reproduction of pinyon is common on 7M, hence the series assignment above.

Management as a Relict Area

7176 Mesa falls within a lobe of the Wilderness Subzone that overlooks the roaded and grazed Natural Environment Subzone of Cathedral Valley. The mesa's zoning is appropriate; it is a "miniwilderness" that no vehicles could reach. No special management measures are necessary to protect relict status. Although 7M need not be patrolled, we recommend that park staff acquaint themselves with the summit environs; it is truly a special and unduplicated place in CARE. The presence of a pristine and novel pinyon-juniper woodland association makes 7M highly significant to the park and to the regional Research Natural Area endeavor. Although its summit is below the size threshold, we encourage RNA candidacy for 7176 Mesa.



Map II.5. Location and boundary of 7176 Mesa. Solomons Temple 7.5' quadrangle. Photo-point 1607 shown by "X".

Table II.7 Vascular plant species list for 7176 Mesa, Capitol Reef National Park. Observations made on May 29, 1990.

Trees

Juniperus osteosperma
Pinus edulis

Shrubs

Amelancher utahensis
Artemisia bigelovii
Artemisia pygmaea
Cercocarpus intricatus
Cercocarpus montanus
Ephedra torryana
Eriogonum corymbosum
Eriogonum microthecum
Purshia mexicana
Shepherdia rotundifolia

Grasses & Grass-Like Plants

Agropyron dasystachyum
Bouteloua gracilis
Elymus salinus
Hilaria jamesii
Stipa hymenoides

Forbs and Cacti

Arenaria fendleri
Astragalus spp.
Castilleja chromosa
Cryptantha flava
Encelia opsis nudicaulis
Erigeron compactus var. *consimilis*
Happlopappus armeroides
Helianthella microcephala
Hymenopappus filifolius
Hymenoxys acaulis var. *arizonica*
Hymenoxys richardsonii
Lesquerella intermedia
Linum aristatum
Macheranthera grindeloides
Oenothera brachycarpa
Oenothera caespitosa
Opuntia polyacantha
Oxytropis lambertii
Parthenium ligulatum
Petradoria pumila
Phlox austromontana
Senecio douglasii
Stephanomeria tenuifolia



Figure II.9 The mesa's northwestern (left) and southern (right) sides, viewed from the "mainland" to the west. The access route proceeds from the bottom to the center of the photo.

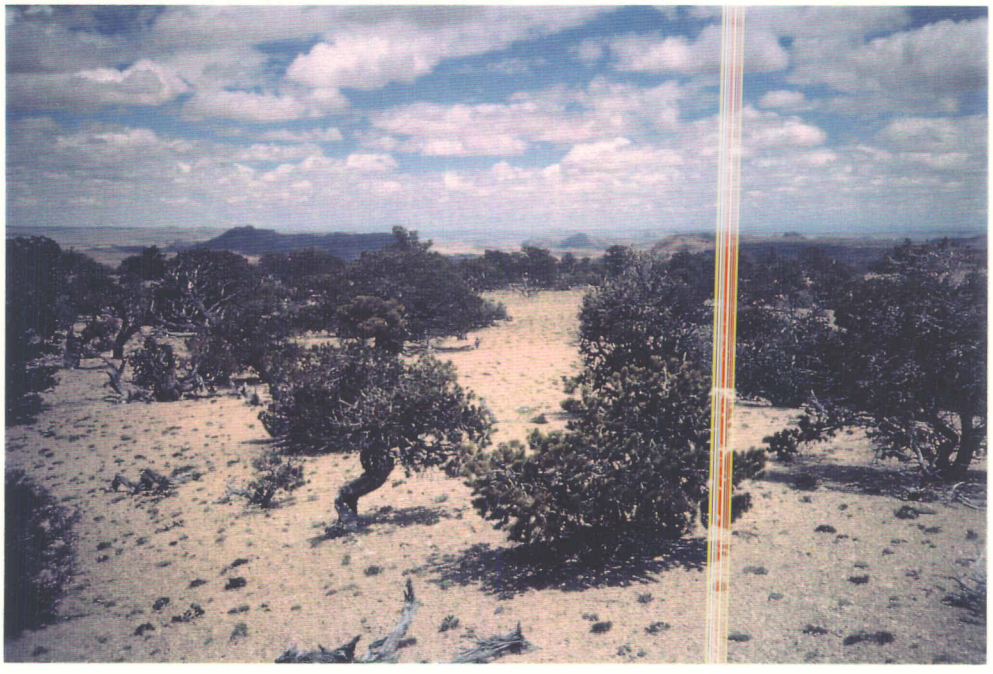


Figure II.10 The pinyon-juniper woodland atop 7176 Mesa. The squat, misshapen character of many of the trees is evident here.

BLOWOUT FLAT

Introduction

Grasslands on the northern Colorado Plateau comprise a very small proportion of the landscape, and they are seldom without the effects of livestock. They are therefore among the most precious and interesting of relict sites. In Capitol Reef, hardly any sizeable grasslands have escaped historic and continuing grazing use. One example, which Spence surveyed, is Longleaf Flats near Fruita. That place is in comparatively good shape, but native graminoids are much scarcer than they probably were. Truly pristine sites are probably found hidden in the recesses of the Waterpocket Fold.

One such enclave is "Blowout Flat" (BF), just northeast of Golden Throne (Map II.6). The origin of the site's unofficial name is unknown. Blowout Flat is compact, rich in species (Table II.8), and completely unaffected by backcountry recreation or other contemporary human influences (Figures II.11 and II.12).

The Wayne County endemic plant, Rabbit Valley gilia (Gilia caespitosa), was believed to grow here. Although the gilia is not rare in the park, it is listed as Threatened and would provide an important supplemental value at BF. It turned out to be rather scarce on the walls around BF (Figure II.11, upper right corner).

Schelz, Spence and Van Pelt visited BF on May 24, 1990. We compiled a thorough plant species list (Table II.8), emplaced a photo station (Figures II.11 and II.12), and extended and read a frequency transect from the station nadir. Conditions were ideal for plant identification and photography.

Location and Size

Blowout Flat is situated in southwest-central Wayne County, Utah. The site is about 7.4 airline miles southeast of the park Visitor Center, and about a mile north of Capitol Gorge (Map II.6). Blowout Flat is about one-sixth mile wide and six-tenths mile long, and contains around 54 acres. The site as demarcated on Map II.6 has much more than the featured grassland; most of the additonal, overlooking acreage is on the north and west sides. Our intent was to include, insofar as map scale permitted, the entire amphitheater above the pouroffs on the eastern side.

Accessibility

Reaching BF is moderately difficult. The drive to the head of Capitol Gorge is via a well-signed gravel road taken by thousands of visitors each year (in any kind of vehicle). We parked at the Golden Throne trailhead. The hike in via the gorge and an unnamed wash is not long or arduous, but requires purposefullness. It is easy to get in the wrong sidecanyon.

The "correct" route (purposely not shown on Map II.6) joins the gorge east of Pioneer Register. About 2 hours of continuously uphill walking will take the hiker through a notch at the head of the drainage, whereupon BF is in full view. The country surrounding BF, at least to the south, has many barriers to hooved-animal movement and is practically devoid of forage or permanent water. Thus, much buffer land has sheltered the site from cattle and cowboys. Refer to page 25 in Olson and Olson (1986) for a picture of the vicinity. Blowout Flat lies below and to the right of Golden Throne.

Relict Character

We confidently concluded that BF is a grazing relict. Park staff do not know of any intruding stock trails. Nonetheless, we were initially concerned about barriers on the east side, fearing that stock could have worked their way upcanyon from the rangelands around Notom. However, that side has 100 to 200-foot pouroffs. We saw no evidence of visitors, whether in the form of trailing, campsites, or trash. Although a hiker or two may come through here from time to time, we think that no groups have ever visited BF. Exceptionally peaceful, scenic, and cloistered, Blowout Flat has yet to be "discovered", fortunately.

Geology and Terrain

Blowout Flat has little-vegetated outcrops of Navajo Sandstone. The grassland itself is an enclave of deposited sediments (probably mainly waterborne) from the Navajo and the Carmel Formation above it. Within the slickrock matrix, hummocky or pocket/crevice deposits are stabilized by greenleaf manzanita (Arctostaphylos patula) shrubs.

The "flat" is not really so (Figure II.11). The surface is not markedly dunelike, however. It is very well-stabilized, having no "blowout" areas. The depositional area is traversed by two washes that are 15 to 20 feet lower than the "ridgelines" (Figure II.11). These drainageways have filled-in (aggraded) channels and sideslopes, with essentially no less vegetation than the higher ground. Scouring floods are probably quite rare, but violent. Fifteen- to thirty-foot-long sections of slickrock channel alternate with angular, rocky fragments and sand. No "pseudoriparian" element is present.

Vegetation

The flat is tree-dotted, but it is not a savanna. A half-dozen ponderosa pine occur, but the trees are chiefly spreading pinyon and juniper. About forty pinyon snags (probably drought-killed) are scattered about (Figure II.12). However, they are outnumbered by live and vigorous stems (Figure II.11). Less prominent are clumps of manzanita and dwarf mountain mahogany (Cercocarpus intricatus). The rest of the vegetation is essentially herbaceous (Figure II.11, foreground).

The "grassland" can be considered an attenuated woodland in cover, structure and key plants, superimposed on an impure, both grass- and forb-dominated community with a definite shrub component. Nonetheless, Heil and others' (1991: 10-11) "aeolian grassland" is the best applicable label. Their writeup does not mention the Artemisia friqida and the Cryptantha species that are so prominent in BF, however. The purest parts of the grassland are basically Stipa comata and S. hymenoides-dominated. Off the "ridge", concave slipfaces support more Sporobolus and Muhlenbergia plus Cryptantha flava, Hymenoxys sp., and Hymenopappus filifolia.

The overlooking slickrock habitat supports good examples of the "dwarf mountain mahogany/slickrock" variant of pinyon-juniper woodland (Heil and others 1991). This type is closely associated with the Navajo Sandstone.

In terms of our classification, the types present appear to be:

1. **Juniperus osteosperma-Pinus edulis/Cercocarpus ledifolius--JUOS-PIED/CELEIN.** (The same as "dwarf...slickrock" above).

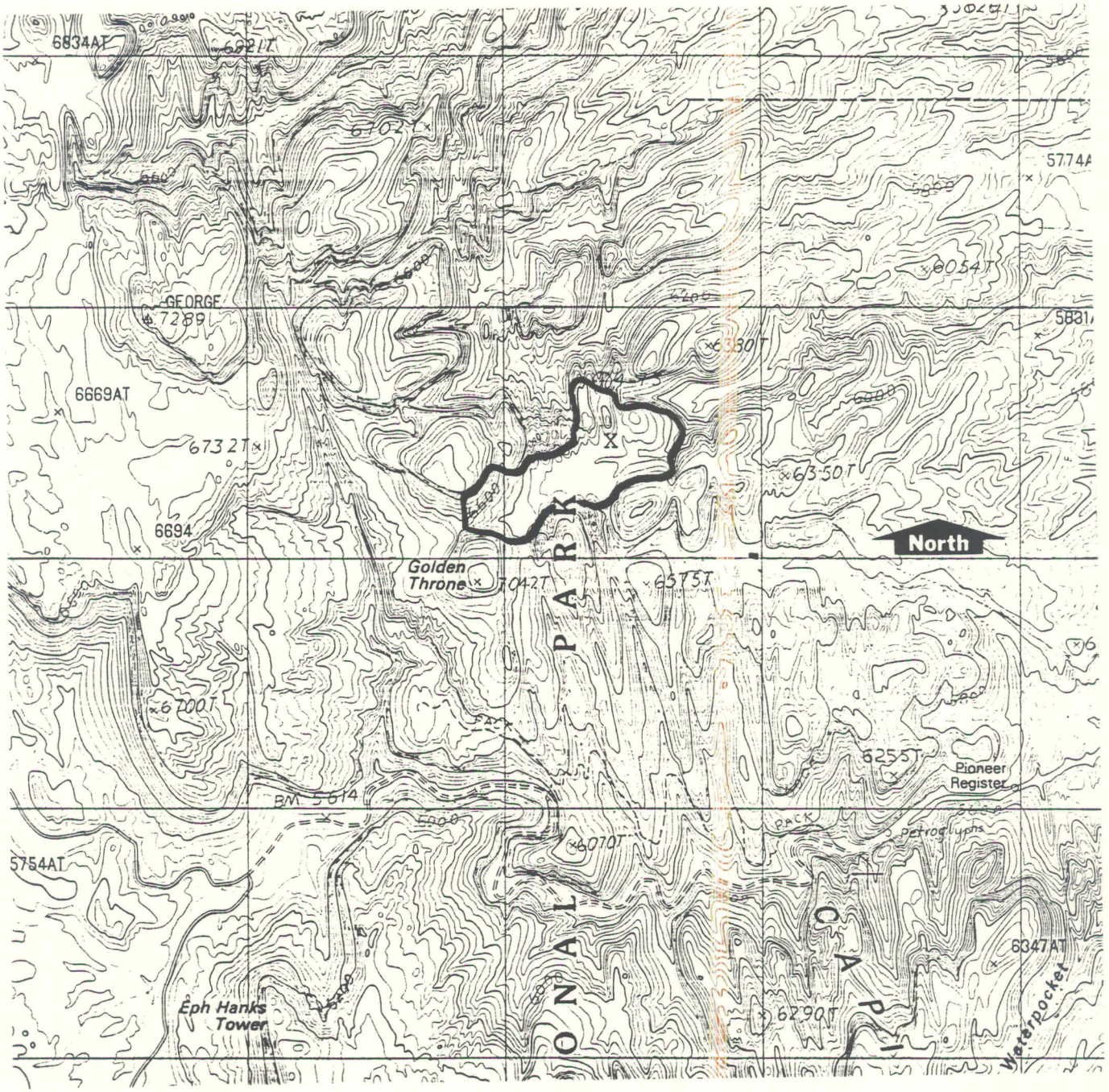
2. **Stipa comata Grassland--STCO.** (Not a very good fit).

3. **Pinus ponderosa/Arctostaphlyos patula--PIPO/ARPA.** (Fragmentary).

Management as a Relict Area/Regional Significance

Blowout Flat is well (and appropriately) embedded in the Wilderness Subzone. Beyond this zoning, we think it is extremely important that deterioration of the site's vegetal cover not be allowed to begin through the passage of curiosity-seekers or educational groups. This is the most publicity-sensitive of all the sites we inspected in CARE. Fortunately, the few Gilia caespitosa plants here are out of harm's way. No interventionist measures appear to be needed to perpetuate BF's relict character, but a closure to visitation may someday be justified.

Blowout Flat is a fine albeit small example of a relict grassland. We think that composition at particular Plateau sites is rather highly individuated, with greater or lesser departure from the "holotype" (Heil and others 1991). Research Natural Area status should be considered by NPS managers, but keeping the site out of the public eye is of paramount importance to its protection. The size minimum of 100 acres would need to be waived here (as for 7176 Mesa), but doing so could probably be justified. Research access would have to be tightly controlled, in any case. "Grassland", "woodland" or something in between, this is a fragile site.



Map II.6 Location and boundary of Blowout Flat. Golden Throne 7.5' quadrangle. Photopoint 1602 shown by "X".

Table II.8 Vascular plant species observed at Blowout Flat, Capitol Reef National Park, on May 24, 1990.

Trees

Fraxinus anomala
Juniperus osteosperma
Pinus edulis
Pinus ponderosa
Salix exigua

Shrubs

Amelanchier utahensis
Arctostaphylos patula
Artemisia bigelovii
Artemisia frigida
Cercocarpus intricatus
Chrysothamnus nauseosus
Gutierrezia sarothrae
Holodiscus dumosa
Sherpherdia rotundifolia
Symphoricarpus longiflorus

Grasses & Grass-like Plants

Andropogon glomeratus
Aristida purpurea
Carex rossii
Hilaria jamesii
Muhlenbergia pungens
Poa fendleriana
Sporobolus cryptandrus
Stipa comata
Stipa hymenoides

Forbs and Cacti

Abronia fragrans
Androstephium breviflorum
Antennaria parvifolia
Arabis pulchra
Arenaria fendleri
Artemisia ludoviciana
Calylophus lavendulafolia
Castilleja chromosa
Cirsium undulatum
Cryptantha flava
Cryptantha sp.
Cymopterous beckii
Erigeron flagellaris
Euphorbia fendleri
Gilia ivesiana
Heterotheca villosa
Hymenopappus filifolia
Hymenoxys sp.
Linum aristatum
Lucelene ericoides
Macheranthera grindeloides
Oenothera pallida
Opuntia sp.
Orobanche ludoviciana
Petrophytum caespitosum
Sphaeralcea coccinea
Stephanomeria tenuifolia
Taraxicum officinale
Thelosperma subnudum
Townsendia incana



Figure II.11 Looking downcanyon from the main "ridge" at the site. Rabbit Valley gilia plants grow sparsely in the jointed sandstone face on the right side. Tarantula Mesa in the distance. The camera is placed at the photopoint.

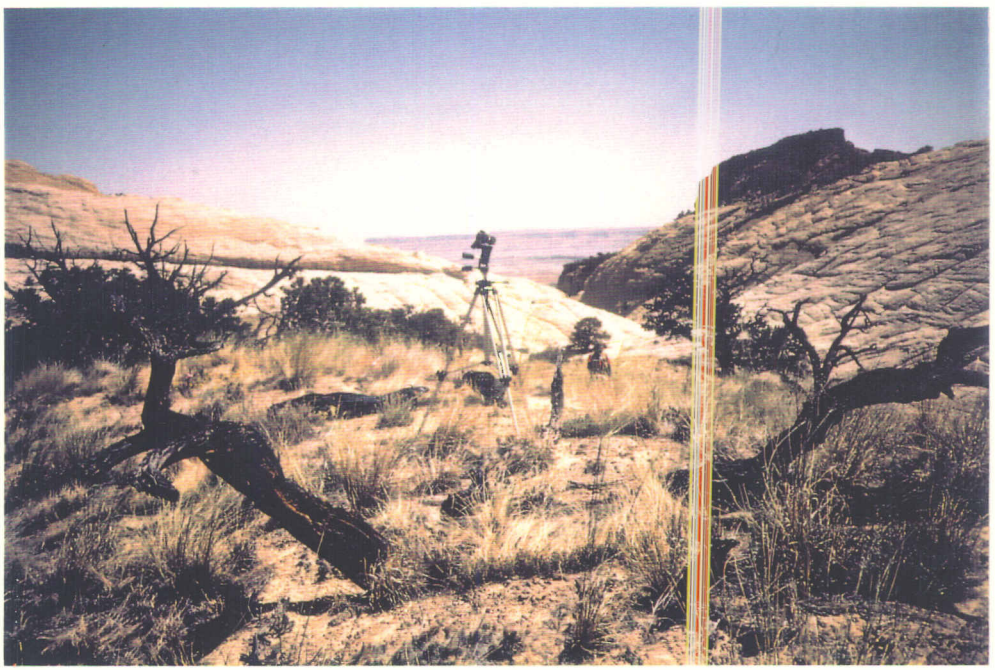


Figure II.12 The camera tripod set up over the photopoint. In the foreground is a charred, weathered Utah juniper snag.

COHAB CANYON FLATS

Introduction

John Spence suggested a small site that he had noticed during botanizing walks on the rimrock overlooking Fruita. "Cohab Canyon Flats" (CCF) is about one-half mile east of and roughly 500 feet above the historic district (Map II.7). Reached by a well-used trail that starts near the campground, CCF is accessible to visitors yet shows no signs of deterioration. We surveyed the site as an attractive special case that is almost certainly not relict yet exhibits high-condition woodland and grassland communities. The imprint of modern man is unnoticeable, except for the last few hundred feet of trail. Developments are, however, amply visible from the interior and edge of CCF.

Led by Spence, Schelz and Van Pelt inspected CCF on May 23, 1990. We compiled a plant species list (Table II.9), walked the length and breadth of the site, and installed one photo station (Map II.7 and Figure II.14; Schelz and Van Pelt 1990). Off the trail, the station is identified by tag "1601".

Location and Size

Cohab Canyon Flats is situated in west-central Wayne County, Utah. General locality descriptions for the Fruita environs would apply very well. The site is northeast of but not visible from the large, popular campground. The northern margin of CCF overlooks the Fremont River and Highway 24 (Map II.7). The site is directly south of Hickman Natural Bridge.

Cohab Canyon Flats extends for about one-quarter mile west and east, and for one-tenth mile (roughly 500 feet) north and south. The boundary on Map II.7 includes about 13 acres and is predominately "topographic".

Accessibility

The best way to reach the site is via the signed Cohab Canyon Trail, which winds on over toward Behunin Cabin. The trail starts off from the Capitol Gorge road, across from the campground. The section of tread that goes across the western side of CCF is a spur. The walk to the area takes 45 minutes or so, and moving about within it is easy.

Relict Character

Cohab Canyon Flats is not topographically defended from livestock, so it was almost certainly grazed in the late 1800's and early 1900's. However, the Fruita area has not seen permitted or trespass cattle for many years. Because the nature and severity of grazing can only be conjectured, there is little sense in trying to evaluate it here. Complementing the assured lack of recent grazing is the absence of recreational trailing, horse manure and trails, man-made structures, exotic plant species, signs of woodcutting, and evidence of unnatural erosion.

One influence to consider is deer (*Oedicoileus hemionus*) browsing. Oftentimes, wintering herds congregate around Fruita. The site's dominant shrubs are not very palatable to deer, so their prominence might reflect long-term selective browsing.

Geology and Terrain

Quaternary terrace gravels are exposed over nearly the whole area.

Volcanic cobbles from the High Plateaus are embedded in the thin soils, but seem to have contributed little to their development (Figure II.13). The parent material contains much clay, gravel, silt, sand and cobbles.

The site's topography has four "steps" separated by steeper "breaks". The steps are successively smaller from high to low and from west to east. The flats have grassland (Figure II.14) and the breaks have juniper woodland (figure II.13), with substantial intergradation. About 250 feet of vertical relief is present, from the eastern rim up to the western boundary.

Vegetation

The two communities present at CCF are assignable to the shadscale-grassland and juniper-ephedra types of Heil and others (1991). However, shadscale (Atriplex confertifolia) is absent (Figure II.14). Also, a juniper-buffaloberry (Shepherdia) association would probably be more apposite for the woodland (Figure II.13). Types present according to Table II.1 are:

1. **Hilaria jamesii Grassland--HIJA.**

2. **Juniperus osteosperma Series--JUOS.** (The woodland is distinctly Utah juniper-dominated, but pinyon are present. A notable plant is Mirabilis multiflora under tree crowns).

The site harbors no rare or endemic plant species, but the delicate composite Psilostrophe sparsiflora is worth seeking out for observation and photography. Although not a Wayne County or northern Plateau endemic (Welsh and others 1987), greenstem paperflower is by no means common in the park and elsewhere.

The largest flat, traversed by the trail, is also the "best developed". The herbage is taller here than on the lower steps, and the ground surface is less rocky. Evidence of woodland-grassland flux is lacking, whether in the form of tree snags in the open or, conversely, patches of juniper "invasion". Living trees are densest where the volcanic erratics are most prominent.

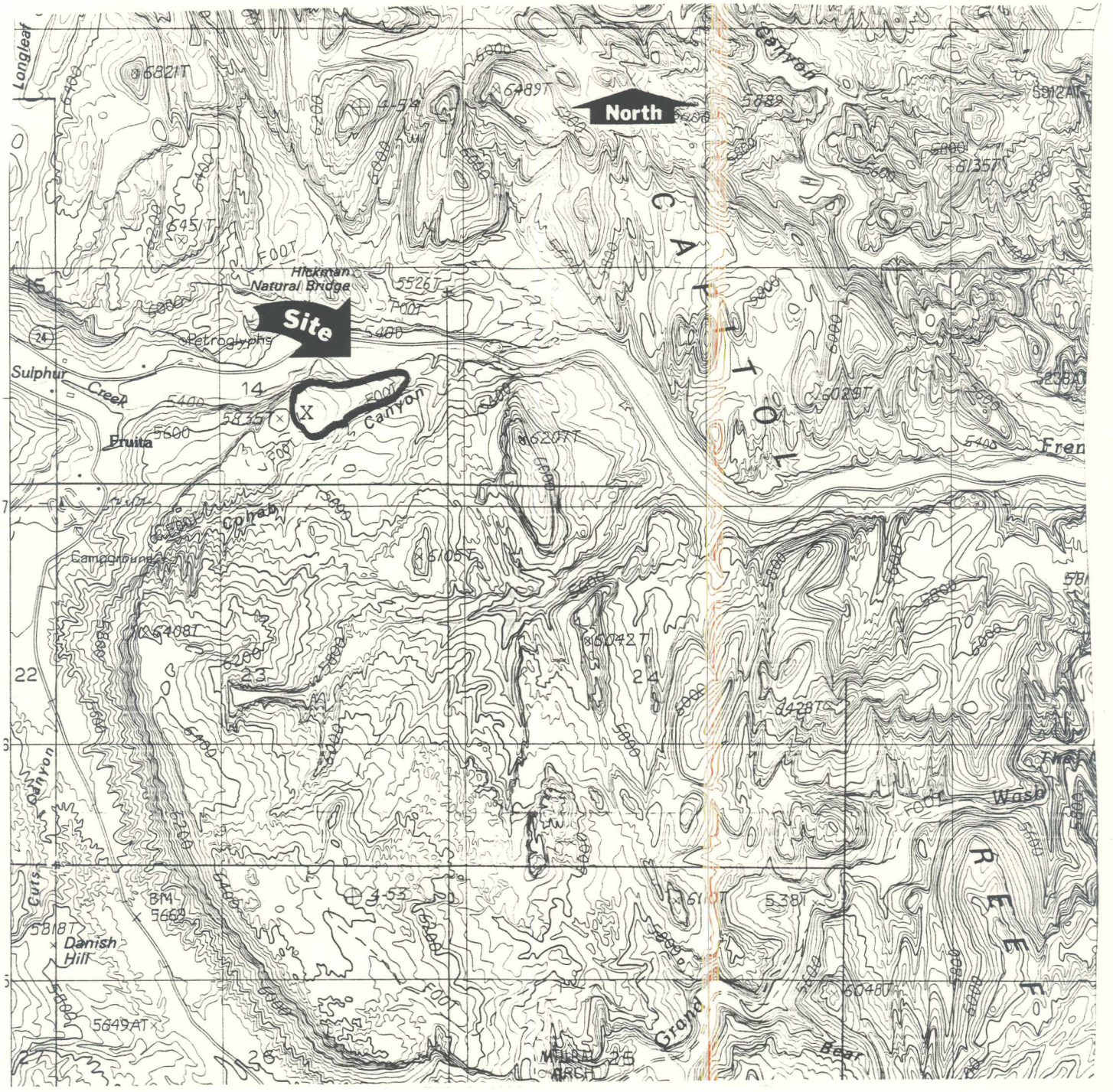
Management as a Relict Area

Cohab Canyon is no longer a relict vegetation site, so no special measures are pertinent. The site is also nonwilderness, unlike other relict survey sites in CARE. Also, the Park Service does not have the option of nondisclosure--people already can easily get to and walk through CCF. Fortunately, no closure or restrictions are warranted. Trail proliferation has not begun. On a more positive note, CCF may afford some interpretive opportunities based on guided ranger walks.

Regional Significance

Cohab Canyon Flats is of no importance to the building of a Research Natural Area network for the Colorado Plateau. It is much too small to qualify as an RNA candidate, it has almost surely been grazed, and its communities do not well typify those of our governing classification or of Heil and others (1991). Some compositional changes may be a result of livestock use or some other historical influence we can no longer deduce.

We inspected the place because it was unmarred and close to our temporary base at CARE headquarters. Cohab Canyon Flats typifies the small to very small vegetation stands that occur in this convoluted and often inaccessible rockscape. No doubt other benchlands in pristine condition could be found, perched above the canyonbottoms of the Fold.



Map II.7 Location and boundary of Cohab Canyon Flats. Fruita 7.5' quadrangle. Photopoint 1601 shown by "X".

Table II.9 Vascular plant species observed on the Cohab Canyon Flats, Capitol Reef National Park, May 23, 1990.

Trees

Juniperus osteosperma
Pinus edulis

Shrubs

Artemisia bigelovii
Atriplex canescens
Cercocarpus intricatus
Chrysothamnus nauseosus
Chrysothamnus viscidiflorus
Ephedra torreyana
Ephedra viridis
Eriogonum microthecum
Sherpherdia rotundifolia

Grasses & Grass-like Plants

Aristida adscensionis
Bouteloua gracilis
Hilaria jamesii
Sporobolus cryptandrus
Stipa hymenoides

Forbs and Cacti

Arabis pulchra
Aster chilensis
Cryptantha sp.
Eriogonum alatum
Erigeron utahensis
Euphorbia fendleri
Hymenoxys richardsonii
Macheranthera grindeloides
Mirabilis multiflora
Psilostrophe sparsiflora
Sclerocactus whipplei
Sphaeralcea coccinea
Thelosperma subnudum
Townsendia incana

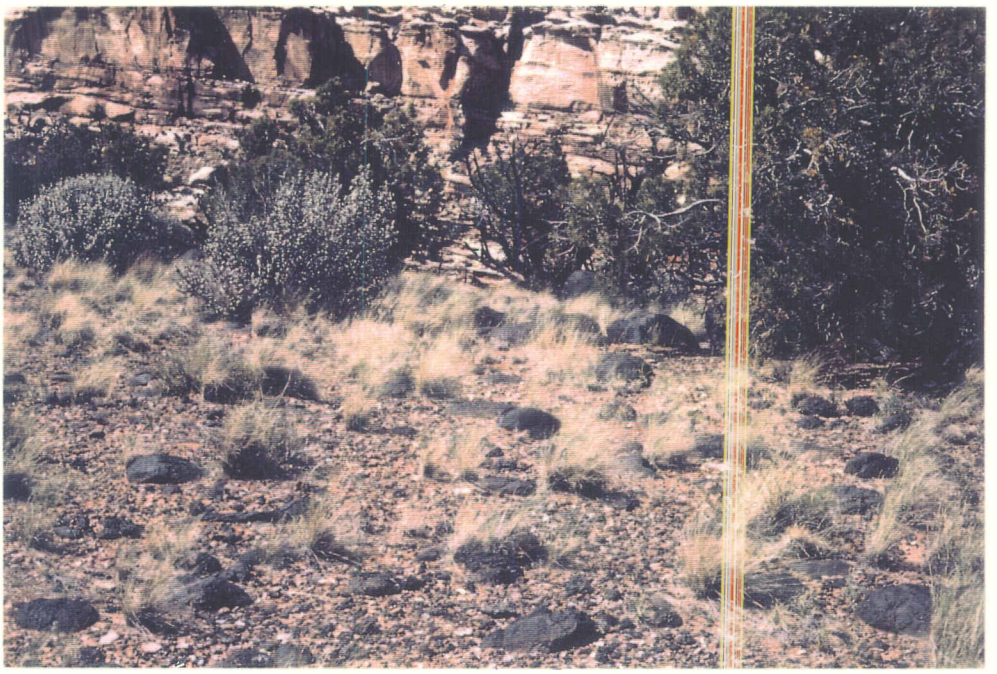


Figure II.13 The woodland and adjoining grassland on one of the lowermost "steps" of the Flats. This picture shows how common and well-embedded the volcanic cobbles are. The prominent grey shrubs are roundleaf buffaloberry.



Figure II.14 The tripod at the photopoint established at the uppermost area of the Flats. The view is northward, across the Fremont River. Fruita lies beyond and below the photo's left-center.

FREMONT RIVER GORGE

Introduction

Capitol Reef staff and volunteers suggested a survey of the Fremont River's canyon between Fruita and the park's western boundary (Map II.8). They especially wanted documentation of the area's values as a scientific counterweight to a proposed dam, reservoir and water diversion upstream, near Torrey. Although Spence doubted that the gorge contained much relict vegetation, he had found rare plants and a forest moss unknown to southern Utah.

The Fremont River Gorge (FRG) is scenic and surprisingly secluded, considering its proximity to the park's largest concentration of facilities and people. The canyon is nearly 2000 feet deep, and the river banks and adjoining terraces are well-vegetated (Table II.10; Figures II.15 and II.16). This area, which is complemented by public (BLM-administered) lands to the west, is certainly one of Capitol Reef National Park's prime natural environments. It represents a unique conjunction of scenic, botanic, and ecologic attributes. No overlooks are available, however.

Schelz, Spence and Van Pelt walked through FRG from west to east on May 25 and 26, 1990. We emplaced two permanent photo stations (Map II.8; Schelz and Van Pelt 1990) and made supplemental notes on vascular plants of the area. Our joint observations at various times were used to compile Table II.10.

Location and Size

The Fremont River Gorge is situated in west-central Wayne County, Utah. The demarcated area (Map II.8) is one to three miles west-southwest of Fruita. The western boundary is about 7 miles southeast of Torrey, the nearest town. Once the prospective visitor has arrived in this part of Capitol Reef, little orientation is needed to comprehend the Gorge's location and to find starting points for west-east or east-west hikes into it. The area is about 2 air miles long and from four-tenths to two-thirds mile wide (Map II.8). The boundary includes roughly three river miles and around 581 acres.

Accessibility

The Gorge can be reached from either the campground/Griffith House area of the Fruita district, or over public lands. The first alternative requires a car shuttle if hikers plan to go one way, westward, through the Gorge. From Torrey, one should take Highway 12 toward Grover and then turn off on a track along the north side of the river. Shadeless "fisherman's" parking is available there. About four hours of hiking are needed to reach FRG's western boundary (Map II.8). The public-land stretch of the river is scenic and peaceful but not particularly dramatic. An unmaintained trail eases walking, but fades toward the park boundary.

Walking through the trailless Gorge is straightforward albeit slow. Persons with a wide range of abilities can make the trip (overnight or during a longish day), but they must be willing to wade in often unshaded reaches of the canyon. Packstock and vehicles are not suited for the journey.

Relict Character

The Fremont River Gorge lacks definitive barriers to livestock, and we found manure at several points on the riverbank. Signs of grazing were less

obvious, but the riparian zone has sufficient regenerative capacity that it could have recovered from harder use in years past. The park's western boundary is unfenced. Recreational use is negligible in influence.

No tamarisk (Tamarix) stands are present, fortunately. The only other exotic plant species of note is Bromus tectorum, which occupies rather small, discontinuous patches. No large stands of this flammable grass are present.

The waters and thus the riparian vegetation of FRG are completely subject to upstream influences. The most recent insult was an accidental release of rotenone from a spigoted Division of Wildlife Resources tank. The discharge, which may have resulted from vandalism, occurred in November 1991. Rotenone is used to poison undesirable fish so that a sport fishery can be enhanced. Other forms of stream life besides trout were drastically harmed. The DWR used a permanganate solution to neutralize the rotenone, turning the river waters purple. The effects were visible at Fruita as well as in the Gorge. A report of this incident appeared in the January/February 1992 issue of the Utah Wilderness Association's newsletter.

The Fremont River Gorge cannot be considered a genuinely relict area as a whole. However, the canyonsides no doubt harbor pristine (and inaccessible) vegetation (Figure II.15). Limiting the survey to cliffs and ledges would preclude description of the riparian hardwood communities, which are "real" and not overtly altered (Figure II.16).

Geology and Terrain

The area's stratigraphy is simple. The highest unit is the Kaibab Limestone, the inner one is the Cutler Group, and the channel is a combination of Cutler bedrock and alluvium from sources upstream. Very little volcanic material, in the form of rounded extrusive erratics (Olson and Olson 1986) is apparent, in contrast to the public-land stretch upstream. Refer to Billingsley, Huntoon and Breed (1987) for a description of lithology for the Kaibab and Cutler units.

The Gorge narrows and deepens rather abruptly close to the park boundary; the coincidence with the change in administrative status is rather remarkable. From this vicinity eastward, the Gorge is a profound chasm with unscalable, craggy walls. Even in late spring and summer, the sun disappears from view late in the afternoon or early in the evening.

Three broad terrain units may be distinguished, besides the channel proper. These are a narrow riparian strip, with frequent boulders; aprons of sloping, accessible terrain between the channel and the cliffbases; and the walls of the Gorge (Figures II.15 and II.16. In the canyon's innermost recesses, the cliffs may start nearly straight up from the channel to the uplands of Miners Mountain (Map II.8). The map reveals that the most vertical or nearly-vertical terrain is in the area's center, on the north bank. Given the precipitous topography, no nontechnical access from the north or south is known.

Vegetation

Even discounting the inaccessible terrain, FRG has a rich flora (Table II.10). About 157 native vascular species are present, for an "index" of roughly 0.27 taxa per acre (or one species or variety every 4 acres). The species of greatest note (J. Spence) are these forbs: Cymopterus beckii, Spiranthes diluvialis (a trace, thus far), and Schoencrambe barnebyi. Their respective common names and status under the Endangered Species Act are:

Pinnate spring parsley or Beck biscuitroot	Candidate (C2)
Ute lady's tresses	Proposed Threatened
Barneby thelypody	Proposed Endangered

The area's most noteworthy plant community is the alder-birch riparian type (Heil and others 1991: 49-50; Figure II.16). The comparable types in our classification (Table II.1) are listed below in evident order of importance. The prominent Acer negundo (boxelder; Figure II.16) is not tied to the immediate margin of the river channel, but is certainly shade- and/or watertable-reliant. Blue spruce (Picea pungens) are absent, and cottonwoods (Populus) are not numerous nor a community denominator. Willows (Salix) are an important if subordinate element, often intermixed with wild rose (Rosa woodsii) and Brickellia longifolia, a largish composite shrub.

The secondary vegetation element is probably the pinyon-juniper-tall shrub woodland (Figure II.15; upper left and center top). Observations made in one northeast-facing woodland site, about 400 feet the river, revealed a luxuriantly grassy understory, and large shrubs of Shepherdia, Fraxinus anomala, and Symphoricarpos. The buffaloberry and the singleleaf ash hug the clifftoe and extend onto terracettes where Douglas-fir (Pseudostuga menziesii) grow erect and sheltered. Comparable terrain across the river, with more southerly aspects, lacks Douglas-fir and singleleaf ash. Much Douglas-fir "habitat" on the southern bank's cliffs is inaccessible.

Associations and series present appear to be:

1. **Alnus incana/Cornus sericea (ALIN/COSE).**
2. **Acer negundo/Cornus sericea (ACNE/COSE).**
3. **Betula occidentalis/Cornus sericea (BEOC/COSE).**
4. **Pinus edulis Series (PIED).**
5. **[Douglas-fir] Scarp/Scree Association (PSME/_____).**

Grassland fragments may be present as well, plus Salix exigua/Mesic Graminoid (riparian) (SAEX/MESIC GRAM). The abundance and stature of singleleaf ash in the pinyon woodland or hillside savanna should be used diagnostically.

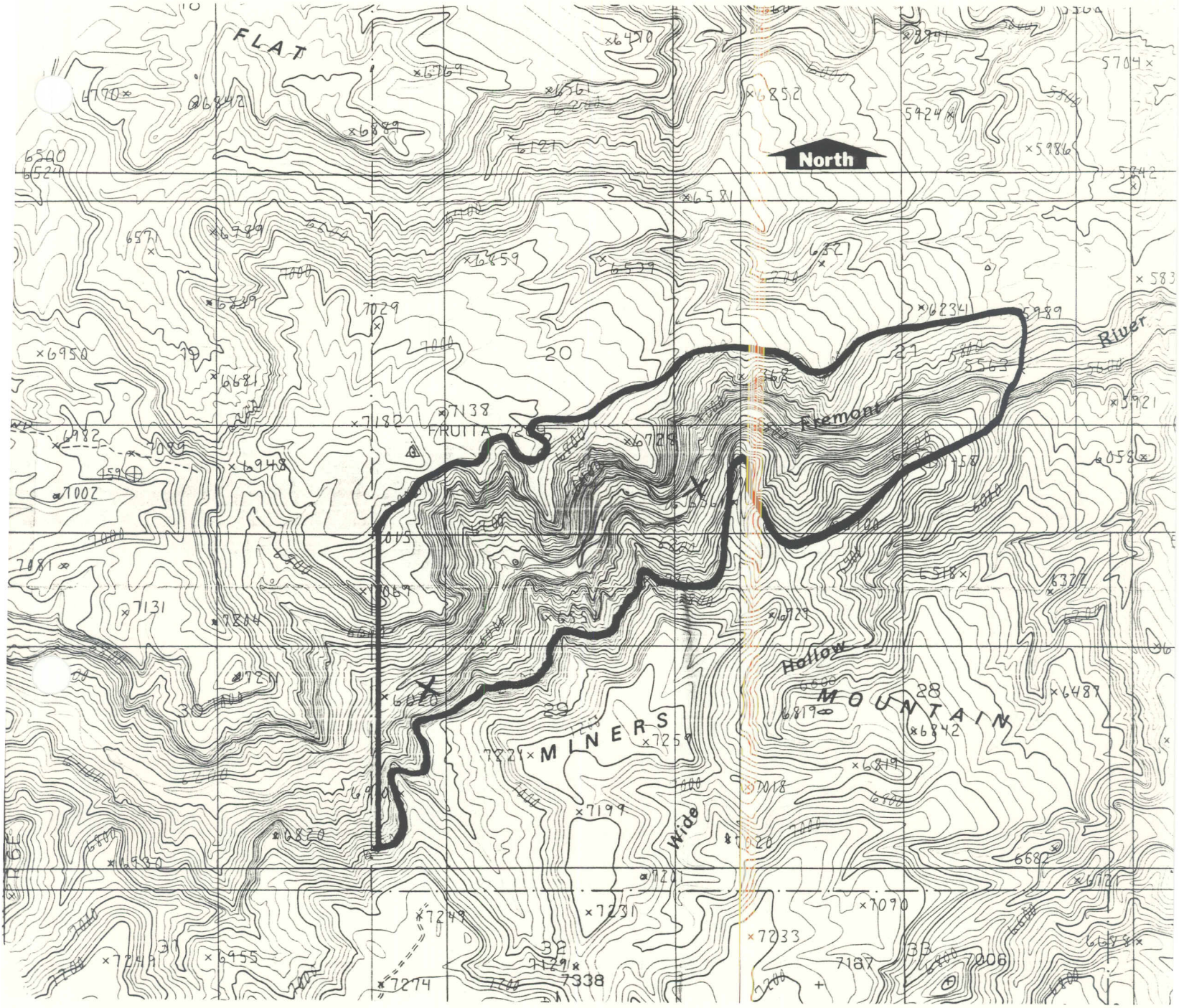
Management as a Relict Area/Regional Significance

Because not all of the vegetation in the Fremont River Gorge can be confidently considered relict, the park's attention should concentrate on preserving its remarkably large flora and on keeping stream parameters close to natural (by whatever criteria). The Gorge evidently falls within the Natural Environment Subzone, but we think that Wilderness (or Wild or Scenic River) subzoning is more appropriate. The Natural Environment label is for substantially unaltered park landscapes where visitors are numerous.

Park staff will continue to monitor and, as is timely, oppose upstream impoundments and diversions. The likely effects on the Fremont River Gorge have been well-estimated, and include intermittent dewatering, diminution of riparian cover, and an increase in tamarisk. Practically none of the anticipated impacts are considered desirable or in harmony with park objectives. The welfare of candidate plant species will loom large in the formulation of a final NPS position on a dam upstream, and in the issuance of permits by the Federal Energy Regulatory Commission.

We see no basis for a closure of FRG to recreationists, or indeed for any restrictions or guidelines beyond those already in effect. Very few visitors venture into the Gorge, and those that do should be allowed to enjoy it respectfully, whether day-hiking or camping overnight. Small groups can use the area if they are careful with tentsites and sanitation.

The Fremont River Gorge would probably not be a qualified addition to the regional RNA network. It shows signs of disturbance, is continually subject to adverse upstream influences, and is attractive to visitors. Nonetheless, it deserves explicit protection, strong defenders, and ongoing studies of its flora, birdlife, and aquatic resources. A botanical special interest area designation may be appropriate someday.



Map II.8 Location and boundary of Fremont River Gorge. Twin Rocks 7.5' quadrangle. Photo-points 1603 and 1604 shown by "X".

Table II.10 Vascular plants of the Fremont Gorge.

Trees

Acer negundo
Alnus tenuifolia
Betula occidentalis
Fraxinus anomala
Juniperus osteosperma
Pinus edulis
Pinus ponderosa
Populus angustifolia
Populus fremontii
Pseudotsuga menziesii
Salix amygdaloides
Salix exigua
Salix lasiolepis

Shrubs

Amelanchier utahensis
Arctostaphylos patula
Artemisia bigelovii
Artemisia frigida
Artemisia nova
Artemisia tridentata
Atriplex canescens
Atriplex confertifolia
Brickellia californica
Brickellia longifolia
Cercocarpus intricatus
Ceratoides lanata
Cornus sericea
Chrysothamnus nauseosus
Elaeagnus angustifolia
Ephedra torreyana
Ephedra viridis
Eriogonum corymbosum
Fallugia paradoxa
Fendlera rupicola
Gutierrezia sarothrae
Holodiscus dumosa
Mahonia fremontii
Purshia mexicana
Rhus aromatica
Ribes aureum
Rosa woodsii
Sambucus caerulea
Shepherdia rotundifolia
Symphoricarpos longiflorus
Tamarix ramosissima

(Table II.10, continued)

Grasses & Grass-like Plants

Andropogon glomeratus
Aristida purpurea
Bouteloua gracilis
Carex nebrascensis
Cheilanthes feei
Eleocharis palustris
Elymus canadensis
Erioneuron pilosum
Hilaria jamesii
Juncus balticus
Juncus ensifolius
Muhlenbergia pungens
Munroa squarrosa
Phalaris arundinacea
Phragmites australis
Poa fendleriana
Sporobolus cryptandrus
Sporobolus airoides
Stipa comata
Stipa hymenoides
Vulpia octoflora

Forbs and Cacti

Abronia fragrans
Androstephium breviflorum
Antennaria parvifolia
Apocynum cannabinum
Arabis pulchra
Arctium minus
Arenaria fendleri
Artemisia dracunculus
Artemisia ludoviciana
Asclepias speciosa
Aster chilensis
Aster pauciflorus
Astragalus lentiginosus
Astragalus praelongus
Brickellia californica
Brickellia longifolia
Castilleja chromosa
Castilleja exilis
Castilleja linariifolia
Chenopodium fremontii
Cicuta maculata
Cirsium undulatum
Cirsium calcareum var. *pulchellum*
Clematis ligustifolia

(Table II.10, continued)

Forbs and Cacti	Forbs and Cacti
Corydalis aurea	*Oxytropis lambertii*
Crepis runcinata	*Penstemon utahensis*
Cryptantha flava	*Petrophytum caespitosum*
Cryptantha sp.	*Plantago eriopoda*
Cymopterous beckii	*Plantago major*
Descurainia pinnata	*Phlox hoodii*
Equisetum arvense	*Phlox muscoides*
Equisetum hyemale	*Phragmites australis*
Erigeron flagellaris	*Psilostrophe sparsiflora*
Erysinum incomspicuum	*Ranunculus cymbalaria*
Euphorbia fendleri	*Rumex crispus*
Gilia aggregata	*Schoencrambe barnebyi*
Gilia subnudum	*Schoencrambe linifolia*
Glaux maritima	*Sclerocactus parviflorus*
Happlopappus armeroides	*Smilacina stellata*
Helianthella uniflora	*Solidago canadensis*
Heterotheca villosa	*Solidago occidentalis*
Hymenopappus filifolius	*Sphaeralcea coccinea*
Hymenoxys acaulis	*Sphaeralcea parvifolia*
Iris missouriensis	*Stanleya pinnata*
Lappula occidentalis	*Stephanomeria tenuifolia*
Linum aristatum	*Tamarix ramosissima*
Linum perenne	*Taraxicum officinale*
Lepidium densiflorum	*Thermopsis montana*
Lesquerella intermedia	*Thelosperma subnudum*
Lucelene ericoides	*Townsendia incana*
Macheranthera grindeloides	*Toxicodendron rydbergii*
Medicago sativa	*Typha domingensis*
Melilotus alba	*Typha latifolia*
Melilotus officinalis	*Urtica dioica*
Mentha arvensis	*Veronica americana*
Mimulus guttatus	*Xanthium strumarium*
Oenothera caespitosa	*Yucca harrimaniae*
Oenothera pallida	
Opuntia polyacantha	
Orobanche ludoviciana	

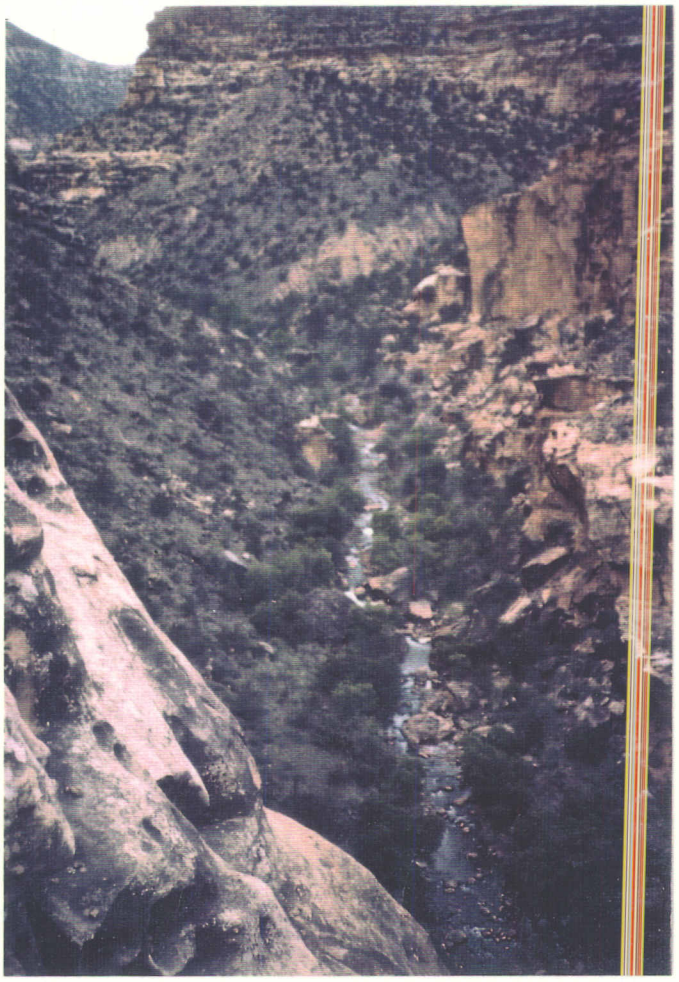


Figure II.15 The inner Gorge, looking upstream to the Park boundary. The riparian fringe is here typically quite narrow, with arid, pinyon-juniper-dotted slopes just above.

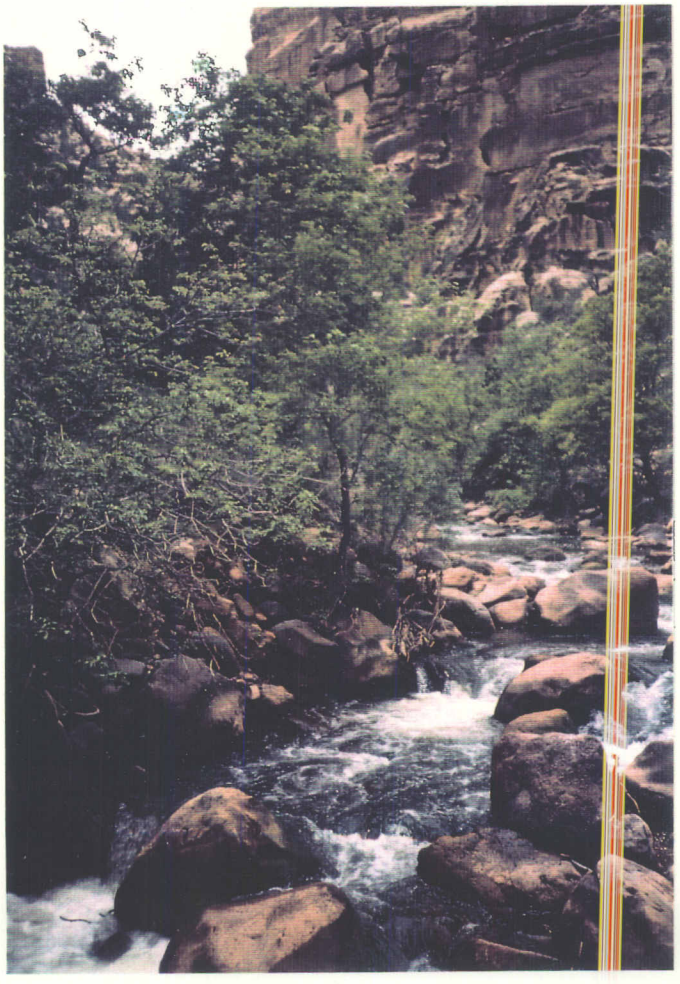


Figure II.16 A closer view of riparian vegetation in the Gorge. The trees are all boxelder. Passage through the Gorge in this stretch involves much channel wading.

HALLS CREEK NARROWS

Introduction

The Narrows of Hall's Creek, at the southern end of Capitol Reef National Park, are unlikely to have been affected by livestock grazing. They are defended by narrow rocky canyon floors, deep water and quicksand. Permanent water, from numerous seeps and hanging gardens, exists in the Narrows, fostering the development of luxuriant riparian vegetation and associated fauna. Several species apparently reach their northern limits in this area, including Habenaria zothecina, Ostrya knowltonii, and the Southwestern Toad (Bufo microscaphus). In addition to riparian vegetation, some aeolian deposits in the Narrows support presumed relict grassland vegetation. The fourth author wrote the following writeup. He elected to use metric units for quantities.

Location and Size

Hall's Creek Narrows consists of about 8 kilometers (km) of a narrowly entrenched canyon in the southern part of Capitol Reef National Park, Garfield County, Utah. It can be located on the Deer Point and Stevens Canyon 7.5 minute topographic quadrangles (Map II.9). Elevation drops from 1260 m at the north end of the Narrow's to 1200 m at the south end. To the east of the Narrows is the high cliff (250 m) of Big Thompson Mesa, while the Waterpocket Fold rises to 2130 meters on the west. The highest point in the area is Deer Point (2215 m), to the northwest.

Within the Narrows, several small benches and patches of riparian woodland occur. The largest of the benches are about 3 hectares, with the largest patches of riparian vegetation about the same size. Much of the vegetation along the creek consists of a narrow riparian fringe enclosed by sheer walls of up to 150 meters relief, with little or no vegetation.

Accessibility

The Narrows can be reached by a hike ranging from 6-13 km, depending on where one drops off the eastern cliff (off of Big Thompson Mesa) of Hall's Creek. From the Hall's Creek Overlook a well-marked trail drops to the canyon floor, c. 13 km north of the beginning of the Narrows. An alternative is to drive to the landing strip, which is located to the south of the Overlook. Again, a steep and rough descent brings one to the canyon c. 6 km north of the Narrows. A third approach consists of walking the rim south to just beyond the lower entrance to the Narrows, and then dropping off the rim. All three approaches are arduous and hot in the summer.

Obstacles to livestock occur 1 km within the Narrows at both the upper and lower ends. In both cases, deep water in narrow rocky channels and patches of mud and quicksand are likely to deter livestock. These areas are passable to humans, and abundant sign of deer in the middle sections of the Narrows indicates they are not obstacles to mule deer.

Relict Character

No sign of livestock activity, including prints, dung or grazing, was observed in the middle c. 5-6 km of the Narrows. However, it is possible that cattle have occasionally penetrated into the middle stretches (N. Henderson, pers. com., 1990). The benches support large, dense tussocks of Stipa and Sporobolus species with abundant dead standing crops which appear to have never been grazed. Limited signs of backpacker and horse camping was observed in the upper end of the Narrows, but much of the middle portion is unsuitable for

camping and no signs of human activity or disturbance was noted. The nature of the vegetation and lack of obvious signs of disturbance suggest that the Narrows is in a relict state. Although the area is accessible to backpackers, very few appear to use the area and it is not at all well known.

Geology and Terrain

The cliffs of Hall's Narrows are formed entirely of Navajo Sandstone. In wide meanders along the creek Pleistocene aeolian deposits occur, some of which are quite extensive (accumulations up to 20 m deep). Much of the canyon floor is rocky, with shallow or nonexistent soils. Permanent water occurs on much of the canyon floor.

Vegetation

The main plant communities of the Narrows are: riparian woodland, riparian shrub-rush, hanging gardens and seeps, and bench grassland.

Patches of riparian woodland, consisting of Acer negundo, Celtis reticulata, Fraxinus anomala, Ostrya knowltonii, Populus fremontii, Quercus gambelii, Rhamnus betulifolia, and Salix species, are found in the meanders of Hall's Creek. Much of the canyon floor and the creek margins is vegetated by a riparian floodplain community, in which Baccharis emoryi, Brickellia longifolia, Juncus balticus, J. ensifolius, Medicago sativa, Oxytenia acerosa, Polypogon semiverticillata, Salix exigua, and Stephanomeria tenuifolia, are prominent. Tamarix ramosissima is rather patchily distributed, and seldom reaches large size (>2 m) except in the upper and lower ends of the Narrows. In drier, sandy areas along the creek can be found Abronia fragrans, Allium macropetalum, Ambrosia acanthicarpa, Asclepias speciosa, Bromus tectorum, Cowania mexicana, Crypthantha confertifolia, Elymus canadensis, Heterotheca villosa, Oenothera hookeri, Penstemon eatonii, P. palmeri, Psoralea lanceolata, Rhus trilobata, Salsola australis, and Tradescantia occidentalis. Although several weedy species were noted along the floodplain of the creek, they are all common species that have established in similar settings throughout the Colorado Plateau, and don't necessarily constitute signs of grazing.

Hanging gardens and related springs (not arising from bedrock) are common throughout the Narrows. Most support Adiantum capillus-veneris as the dominant. Data on a typical hanging garden and a large spring percolating through soil and trickling down a rock face near the middle of the Narrows, are listed in Table II.13. The entire garden was surveyed, while the spring analysis consists of a 10 m X 1 m stretch of the seep along the creek. In both cases, visual estimates of species cover were made without subsampling by quadrat.

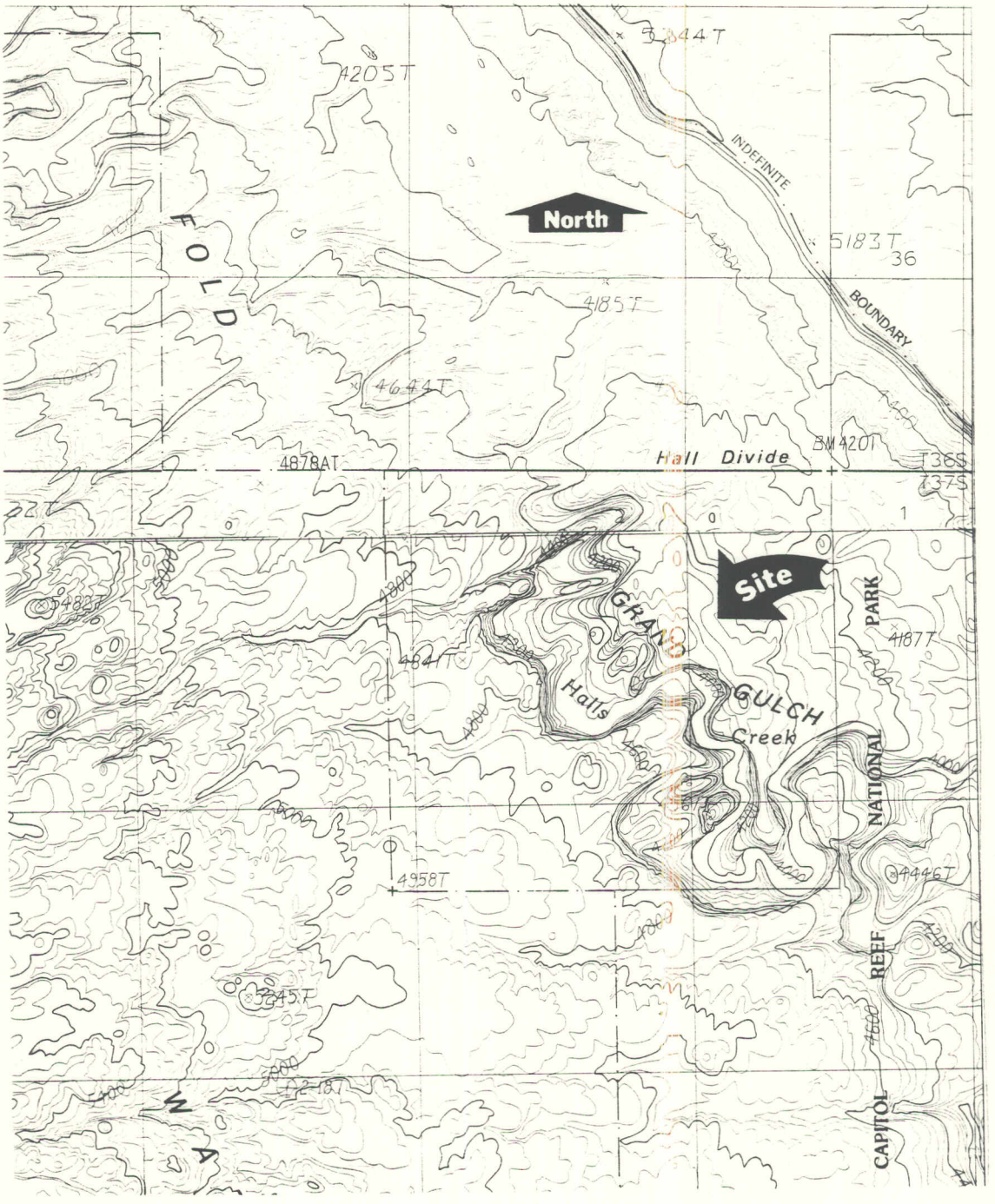
The largest flat-topped bench of aeolian deposits in the Narrows was selected for a permanent transect study. Three 30 m transects were established parallel to one another and 10 m apart. Along each transect, a 20 cm X 50 cm quadrat was randomly positioned 20 times. Species cover was noted using a modified Daubenmire scale. The transect data are summarized in Table II.14. The vegetation of this bench is typical of other benches in the Narrows, and consists primarily of Stipa hymenoides, with small amounts of Amsonia and Lepidium. As few tussocks were flowering, some could have been of S. comata (no flowering of this species was observed). Future data collection will be needed to verify the presence of this species. Abundant standing dead, litter, cryptogamic crust and moss (Tortula ruralis) were found.

Management as a Relict or Near-Relict Area

Current park-management practices are probably adequate to maintain the pristine nature of the Narrows. Grazing has ceased in Hall's Creek both above and below the Narrows. Current visitation rates by humans are very low, although if backpackers begin to use the area more in the future it may be necessary establish new regulations. Among the most important would be to minimize camping and associated disturbances in the Narrows, perhaps by establishing camping zones above and below the Narrows, and only allowing day hiking through them.

Regional Significance

There are several pristine riparian communities to the south of Hall's Narrows in Glen Canyon National Recreation Area. Many species are shared between these isolated communities, and Hall's Narrows is rather typical of canyons like Cow, the east fork of Iceberg Canyon, and lower Wilson (Tuhy and MacMahon 1988). Some of these appear to have been grazed at some time in the past, however. (Tuhy and MacMahon 1988). Hall's Creek lacks the luxuriant species-rich hanging gardens of these other areas, but the riparian woodland vegetation appears to be very similar in all canyons.



Map II.9 Location of Halls Creek Narrows. Due to the linear nature of the area, and to avoid obscuring features, a boundary is not depicted. Deer Point and Stevens Canyon 7.5′ quadrangles.

Table II.13 Cover data for a typical hanging garden and a large spring in the Narrows of Hall's Creek, using the releve method. The scale used is a modified Daubenmire scale, and consists of: t = trace, only a few plants, essentially no cover, 1 = 1-5% cover, 2 = 6-25%, 3 = 26-50%, 4 = 51-75%, 5 = 76-95%, 6 = 96-100%.

Species	Hanging Garden	Spring
Adiantum capillus-veneris	4	4
Mimulus eastwoodiae	3	-
Solidago occidentalis	2	2
Fraxinus anomala	2	-
Panicum acuminatum	1	1
Baccharis emoryi	1	1
Chenopodium fremontii	t	-
Epipactus gigantea	t	2
Populus fremontii	t	-
Parthenocissus vitacea	-	2
Rhamnus betulifolia	-	1
Agrostis semiverticillata	-	1
Carex aurea	-	1
Juncus ensifolius	-	1
Equisetum laevigatum	-	1
Habenaria zothecina	-	1
Phragmites australis	-	1
Toxicodendron rydbergii	-	1
Salix exigua	-	t
Oxytenia acerosa	-	t
Lobelia cardinalis	-	t

Table II.14 Cover and frequency data for 50 m of transect data from relict *Stipa* grassland, Hall's Creek Narrows. There were 50 0.5 X 0.2 m quadrats. Cover was estimated visually using the Daubenmire scale, then converted to median per cent cover.

	Cover	Frequency
Litter	21.1	100.0
Soil	6.9	87.5
Crust	6.7	76.7
Tortula ruralis	25.5	93.3
Stipa hymenoides	9.9	63.3
Ephedra viridis	4.2	21.7
Lepidium montanum	1.0	5.0

UPPER DEEP CREEK

The highest relict-vegetation survey site occurs in CARE's northwestern corner, at almost 9000 feet (Map II.10). Dr. William Romme had sampled and characterized communities in "Upper Deep Creek" (UDC). He encouraged us to visit the site, partly to gain a better perspective on the striking bristlecone pine (Pinus longaeva) there. Unlike the rest of the park, UDC is montane in character and has substantial snowpacks in most winters and early springs. This roadless and trailless site is far removed from visitor attractions, and it lacks interpretive or administrative structures.

According to Heil and others (1991), two of the park's vegetation units are restricted to UDC. These are the bristlecone pine - cushion plant community (Figures II.17 and II.18), and the dogwood - spruce riparian woodland community (not pictured). Excerpted descriptions follow:

> [The bristlecone pine - cushion plant] community occurs only on exposed ridgetops composed of the whitish, laminated, gypsiferous siltstone member of the Carmel Formation (Jc) at elevations above 2600 m (8600 feet). Pinus longaeva is the major tree species. The trees are widely spaced and many appear extremely old, with only narrow strip of intact bark supporting a fragment of living crown. The ground layer stratum is composed largely of cushion plants, including Hymenoxys acaulis, Oxytropis oreophila, Phlox muscoides, Thelosperma subnuda, and Eriongonum corymbosum var. revealianum. (Heil and others 1991: 38).

> [The dogwood-spruce] community is found in small, wet, almost marsh-like riparian sites along upper Deep Creek at elevations of 2425-2605 m (8000-8600 feet). The dominant species are the tree, Picea pungens, and the shrub, Cornus stolonifera. Other species present include Ribes aureum and Alnus tenuifolia. This community is extremely rare and localized in the park; it is known only from two small sites, each of about a hectare in extent. Its distribution elsewhere on the Colorado Plateau is unknown (Heil and others 1991: 51).

We corroborated the occurrence of the cushion plants listed, plus that of Townsendia aprica (Last Chance townsendia; Compositae). The townsendia is listed as Threatened and is a Sevier, Wayne and Emery counties endemic.

Van Pelt reconnoitered the area alone in late June 1989. Schelz and Van Pelt completed the survey on May 22, 1990. We demarcated a boundary, noted plant species (Table II.15), and emplaced two photo stations (Map II.10; Schelz and Van Pelt 1990). Figure II.17 shows the vicinity of the two stations (foreground and upper right), whereas Figure II.18 closely approximates one of the frames in the panorama taken over photopoint 154.

Our interest focused on the scenic core of UDC, whose centerpiece is the "esplanade" (Figure II.17, upper right; Figure II.18). The most picturesque bristlecone, and probably the oldest wood fragments, occur there. We also ventured well east on the ridgeline and saw the blue spruce stands, a little northwest of the esplanade. Our survey (and boundary) did not extend to the floor of Upper Deep Creek, which is admittedly the real "upper Deep Creek". Some sign of grazing appears there.

Location and Size

Upper Deep Creek lies in northwestern Wayne County, Utah. The area is

about seven miles southwest of the junction of Sevier, Emery and Wayne counties. The demarcated site occupies the northwest one-third or so of a lobe of the park that juts into the Fishlake National Forest (FNF).

Upper Deep Creek is about nine-tenths mile long and three-tenths mile wide. At 146 acres, UDC is over the size threshold for candidate Research Natural Areas. The boundary on Map II.10 is topographically defined on the the south and east sides, and it is limited by the park's boundary itself to the north and west. The highest prominence in the immediate area, "Billings 9256", overlooks but lies just north of UDC.

Accessibility

The area is about 24 miles by road and 2 miles by trail from the Capitol Reef Visitor Center. The drive (specific directions should be sought from park staff members) involves going north from Torrey up toward Sulphur Basin on forest route 146 and parking near Sidehill Spring (the road to Sand Flat is not the proper one). The drive is quite slow and tedious, and a four-wheel-drive, high-clearance vehicle is highly recommended.

Because hiking directly across the head of Deep Creek is not possible, an unmaintained Forest Service trail must be taken between Sidehill Spring and Billings Pass. This trail more or less follows the contour through open ponderosa pine and aspen before coming into a low-sagebrush flat at the windy pass. From there one can ascend "Billings 9256" before dropping down to the esplanade (Figure II.17). A Fishlake National Forest recreation map is a helpful supplement to park maps or the most current quadrangle (Map II.10).

Travel within the area is easy, but we recommend caution in hiking over the more delicate-looking surfaces (Figure II.17, foreground and center). Most of the effort needed to cover the area is expended in going eastward. The ridgeline, while not hazardous, descends quite steeply. The area is waterless and can be rather hot in May and the summer months. A horse could be ridden as far as Billings Pass, but the mountain mahogany woodland clothing the south slope of "Billings 9256" is too dense for comfortable passage, mounted or unmounted. No vehicles can easily reach or are allowed in UDC.

Relict Character

Upper Deep and the park boundary in this vicinity are not fenced. The area is entirely defended from livestock and vehicular intrusions on its south and east sides, but cattle have entered the area. We saw some old manure on the ridgelines. The animals must have wandered in from a national forest allotment and, finding no forage, eventually left. This means that UDC is technically not relict in terms of our restrictive criteria, but overt signs of trampling and grazing are absent. Most of the plant species present are inedible or unpalatable (Table II.15).

Signs of humanity are almost absent. We found and cleaned up a very old campsite, which had fragments of a rotted tarpaulin, rusty cans, and an old five-gallon jerrycan. A little wood had been collected for a campfire.

Because most interest centers on the trees and the (non-forage) rare plants, we discount any assertion that the place is not truly relict and would thus be unqualified for RNA or a special designation. Scenic, botanic and scientific interest would seem to outweigh any comparatively trivial or transient impacts from cows or campers. No hot fires have occurred in this open forest growth.

Geology and Terrain

Heil and others (1991) supplied information on the area's Jurassic-era lithology. The only clarification would seem to be a small, infringing outcrop of the Tertiary volcanics that underlie much of the adjacent national forest land. The mountain mahogany woodland on UDC's northwest margin appears tied to basaltic parent material as well as to a south-facing, fairly high-elevation habitat.

The area may be considered as having four terrain units in addition to the southern and eastern slopes of "Billings 9256". These are the esplanade or "table"; two wooded ridges descending to the east, separated by a saddle; and the ravine in which the blue spruce occur. That is a side drainage of Deep Creek, a little downstream from Deep Creek Spring (Map II.10).

The assignment of UDC to the Carmel Formation does not quite do justice to the richness and variegation of the surfaces within the area. These attributes contribute greatly to its charm and, evidently, habitat variety. The vesicular, "badland" soils where most of the cushion plants grow are especially striking in texture and color, and have an appreciable microphytic component. The properties of these nearly-barren soils are unstudied.

Vegetation

Roughly 39 vascular plant taxa are present in UDC. Our list (Table II.15) is probably incomplete, due to lack of time and the date of our visit. Associations or series of the area appear to be:

1. **Pinus flexilis/Pinus longaeva Series (PIFL/PILO).**

2. **Picea pungens Series (PIPU).** (Picea pungens/Cornus sericea would be apposite, if a new association were devised).

3. **Pinus ponderosa/Arctostaphylos patula (PIPO/ARPA).**

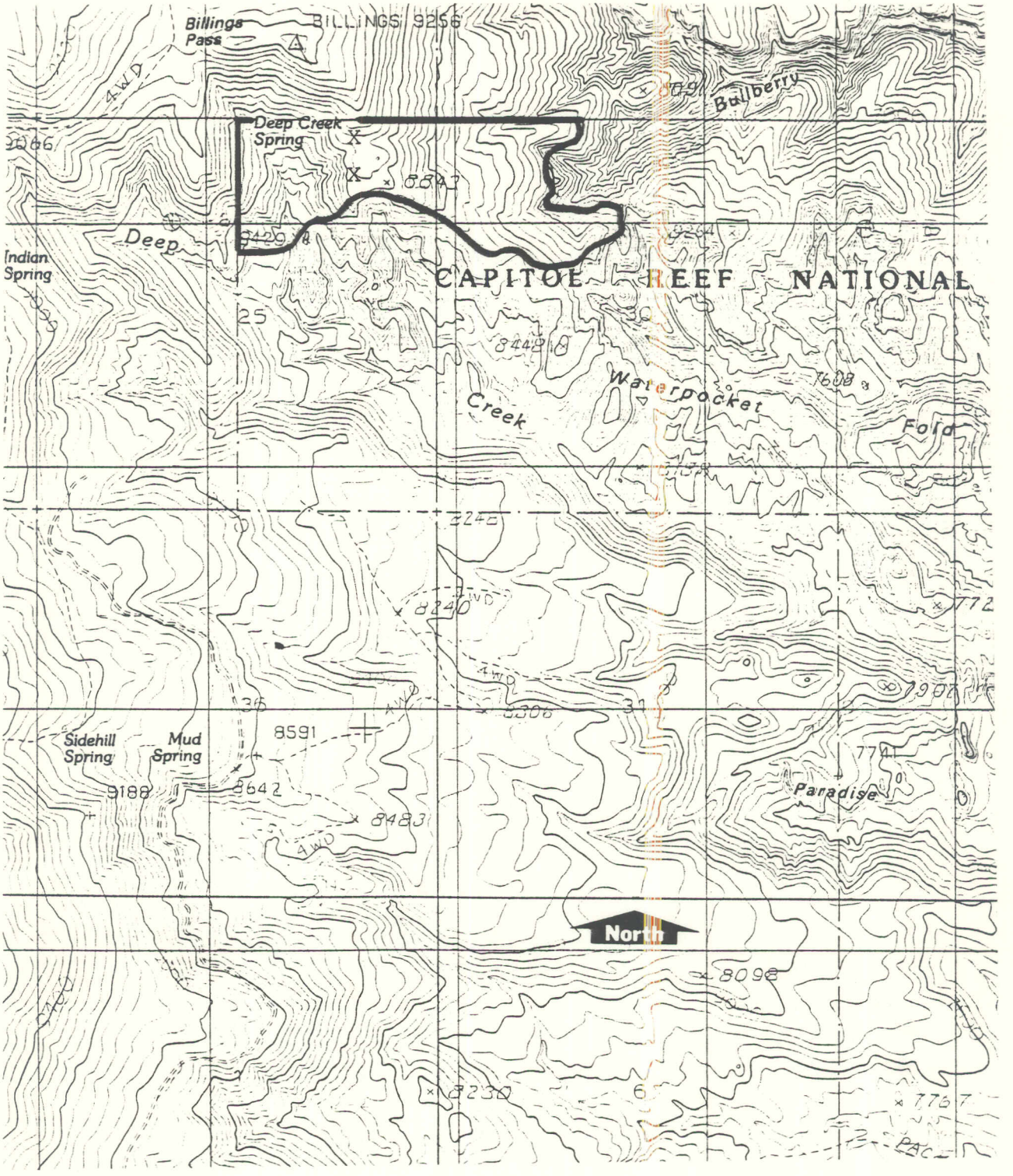
4. **Cerocarpus intricatus (CELE).** (Potential series).

Our classification does not recognize a "cushion plant" association, so if it is amended that might become a new bristlecone pine habitat type.

Management as a Relict Area/Regional Significance

Upper Deep Creek is wholly within the Wilderness subzone, and deservedly so. The area affords a wilderness experience, and it is for all intents and purposes pristine and untrammeled. Solitude is virtually guaranteed except when big-game hunting seasons are in progress on adjacent FNF lands. We can suggest no particular management measures for UDC, except two: prevent the burning and removal of dead wood, and encourage a proper dendrochronolgical evaluation of the bristlecone pine. Heil and others (1991: 38-39) recommend strong protection, too. Van Pelt alerted Drs. D. Graybill and T. Swetnam to the bristlecone's existence, and gave them tree cores. Graybill (1987) has been building a network of bristlecone tree-ring stations in southwestern Utah. Stationed at the University of Arizona, he is the most competent authority for an evaluation of UDC's value to tree-ring science.

Upper Deep Creek exceeds the size minimum for a Research Natural Area on park lands. We recommend that it become an RNA candidate and receive the requisite followup work to our and Romme's surveys (see "Conclusions and Recommendations" below). Upper Deep Creek is a superb natural environment.



Map II.10 Location and boundary of Upper Deep Creek. Flat Top 7.5' quadrangle. Photopoints 153 and 154 shown by "X".

Table II.15 Vascular plant species observed in Upper Deep Creek, Capitol Reef National Park, on May 22, 1990.

Trees

Juniperus osteosperma
Pinus edulis
Pinus longaeva
Pinus ponderosa

Shrubs

Amelanchier utahensis
Arctostaphylos patula
Cercocarpus intricatus
Chrysothamnus sp.
Eriogonum corymbosum
Gutierrezia sarothrae
Purshia tridentata
Shepherdia rotundifolia
Symphoricarpos longiflorus

Grasses and Grass-Like Plants

Bouteloua gracilis
Hilaria jamesii
Stipa hymenoides

Forbs and Cacti

Arabis demissa
Aster sp.
Astragalus spp.
Castilleja chromosa
Chaenactis fremontii
Cryptantha circumcissa
Echinocereus triglochidiatus
Erigeron aphanactis
Hymenoxys acaulis var. *arizonica*
Lesquerella rectipes
Lithospermum incisum
Lucelene ericoides
Oenothera sp.
Opuntia polyacantha
Oxytropis oreophilus
Pediocactus winkleri
Penstemon platyphyllus
Petradoria pumila
Phlox austromontana var. *austromontana*
Physaria newberryi
Townsendia aprica
Townsendia incana
Yucca harrimaniae



Figure II.17 The cushion-plant barrens viewed during the descent from Billings Point. The bristlecone pine forest "table" lies in the upper right. Looking due south; Boulder Mountain on far skyline.

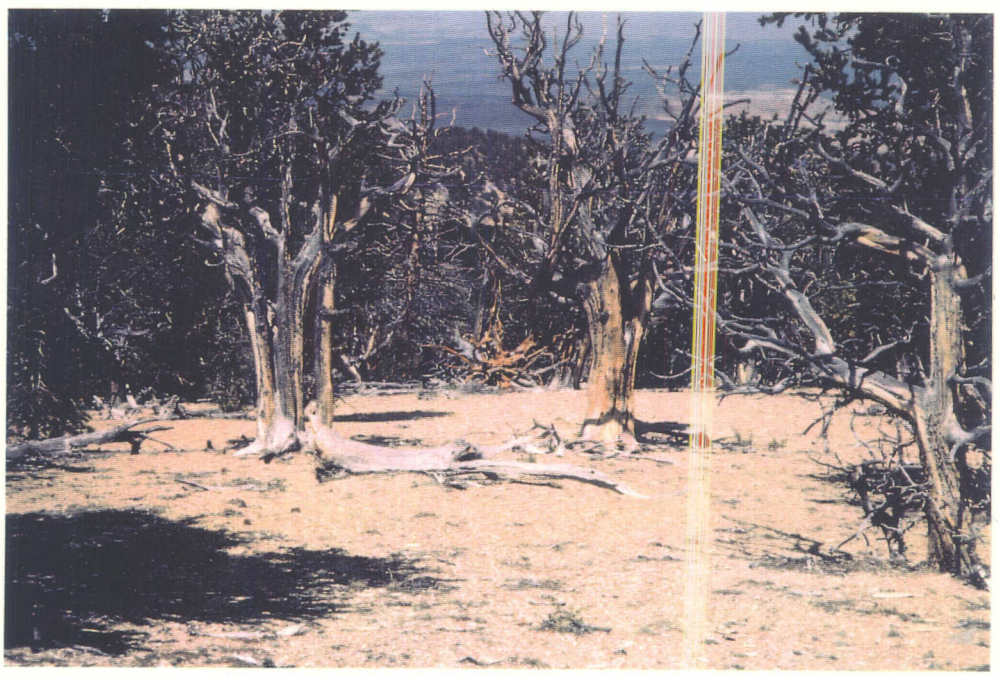


Figure II.18 The interior of the bristlecone pine forest. Both snags and old, strip-bark trees with little remaining foliage are present in this scene.

WAGON BOX MESA

Introduction

Capitol Reef resource manager Norman Henderson suggested that the 1990 survey crew visit Wagon Box Mesa (WBM) in the park's South Unit. He remarked upon the area's small flora--"you can get your species list in half an hour". The mesa is the most discrete and named relict prospect seen in CARE (Map II.11). It is also one of two areas on the northern Plateau whose surface management is shared with the Bureau of Land Management (BLM). The BLM's Escalante Resource Area administers the western half of WBM.

Wagon Box Mesa is a little south of, and is best reached via, the controversial Burr Trail (off of Map II.11). We had hoped that WBM's caprock would be continuous, barring livestock access and ensuring relict vegetation. Schelz, Spence and Van Pelt visited the mesa on May 28, 1990. We installed two photo stations (Map II.11; Schelz and Van Pelt 1990) and compiled a plant species list (Table II.16). Van Pelt inspected WBM's far southeast end. We concluded that the mesa's communities were not pristine, but that they warranted this writeup. Soon after fieldwork, we asked BLM officials for information on land uses and an unexpected road up to the mesa's summit.

Location and Size

Wagon Box Mesa is situated in west-central Garfield County, Utah. The mesa is shown on CRNP's color brochure for visitors, as well as on topographic maps (Map II.11). The Studhorse Peaks are perhaps the nearest prominent landforms, a few miles to the north.

The mesa varies from less than one-tenth mile wide to about seven-tenths mile wide. It is about 2.4 miles long (Map II.11), and consists of about 590 acres. Capitol Reef's share of the mesa's surface is about 280 acres, or 47% of the estimated total acreage.

Accessibility

No detailed driving directions are supplied here, as the paved routes to the Burr Trail (BT) are well-described in free literature. Wagon Box Mesa is easily spotted from sections of the BT above the switchbacks. The turnoff south is about 66 miles from Fruita via the Notom Road. An unmaintained jeep trail leaves the BT's shoulder and winds south, southwest and finally east before coursing up to the mesa's base. A dugway up through the WBM's caprock is not washed out, but large rocks bar vehicles at the last switchback. We walked up from a camp in the northwest corner of Map II.11. Foot (or horseback) travel over the summit is everywhere easy, but drinking water sources are absent and the trees are too short to provide much shade.

Relict Character

The road breaching the caprock has enabled uranium prospectors and, evidently, cows and sheep to roam at will over the summit. There is a proliferation of what BLM terms "ways" -- bladed, usually unauthorized paths that connect prospect pits and have not been recontoured or reclaimed. The ways are concentrated on the west-central part of WBM, and may be seen on large-scale aerial photographs. The highest knoll has the wreckage of geodetic equipment, such as a makeshift tower and guy wires. The BLM/NPS boundary is unfenced.

More positively, WBM lacks overt evidence of cattle, sheep or horses. No woodcutting (fuel or posts) has occurred, and no "chaining" of pinyon-juniper woodlands has been done. Bulldozing of trees was confined to the immediate margin of the ways. Depreciative recreational impacts are absent. There is very little to attract the park visitor to WBM.

According to the reply letter from BLM (dated June 28, 1990), "The Wagon Box Mesa top is currently in the Wagon Box Mesa Allotment. The...top has not been grazed for the past several years, although it has been grazed when snow was available as a source of water...From our understanding the...top was not grazed before the road was built. The [BLM] does not have any plans to rehabilitate the road". The top is now classified "unsuitable" for grazing.

Geology and Terrain

The Shinarump Member of the Triassic Chinle Formation is exposed over the entire summit. Surfaces are gravelley and planar (Figures II.19 and II.20). There are two major knolls in WBM's central and north-central sectors (Map II.11). Total local relief is about 250 feet. The mesa slopes very gradually southward, where the elevation of the rim is just about 7000 feet.

Vegetation

The mesa is entirely covered with a fairly low-statured, open pinyon-juniper woodland (Figures II.19 and II.20). The character of the understory is one of mild local variations in the presence, visibility and abundance of a limited suite of shrubs and low perennial forbs. The mesa is as devoid of grasses as is conceivable. Over acres and acres, plant life consists of trees, Ephedra, Hymenoxys acaulis (stemless woollybase), Yucca, and an occasional, head-high Amelanchier utahensis.

Variations in tree height, stems per acre, and juniper-to-pinyon ratio are mild. The woodland is locally taller and denser on the knolls, especially on the northern slopes where pinyon make up a higher proportion of the stand. No understory shrub is truly constant enough to be an understory denominator for our classification or Heil and others' (1991) scheme. We simply propose:

1. **Pinus edulis Series (PIED).**

2. **Juniperus osteosperma Series (JUOS).**

The closest correlation of conditions on WBM is to Heil and others' (1991) "pinyon-juniper-low shrub". However, the fit is not very good (these authors do not mention visiting WBM).

The constancy of stemless woollybase plants is remarkable (Figure II.19). This composite's presence should be recognized in a phase of the woodland association that could be assigned here, such as Juniperus osteosperma/Ephedra viridis (not in Table II.1). Hymenoxys must reflect some profound soil factor to be so widespread and dominant in the ground layer.

Our plant list (Table II.16) no doubt lacks some taxa that would turn up during more searching. However, even if ten more forms were added to the 31 on the list, only about one taxon per 15 acres would be present on WBM. Elsewhere in the park (on 7176 Mesa) and the Plateau, we surveyed woodland sites with an average of one to two plant species or varieties per acre.

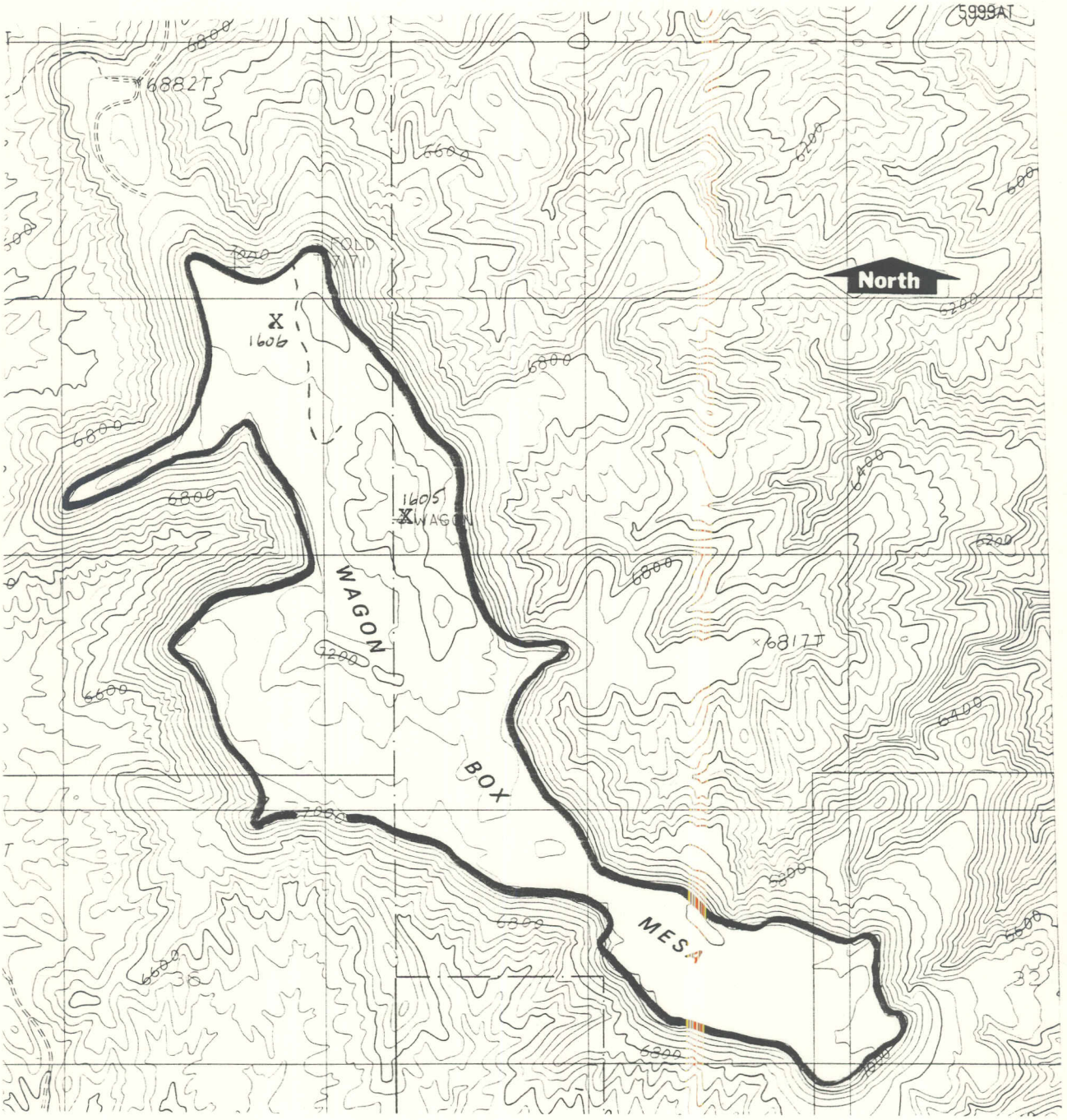
Management as a Relict Area/Regional Significance

Wagon Box Mesa is well-removed from park byways, and it is unaffected by either the Burr Trail or the park-grazing controversies. The area falls within the Wilderness Subzone, but there is an embedded state section that would complicate federal management. Except for one "way", the CRNP part of WBM is roadless.

No active management measures are needed to perpetuate Wagon Box Mesa's once-relict plant communities. The Bureau of Land Management's intentions seem to conform well to defacto wilderness custodianship on the Park Service side. However, we suggest blocking the road at one or more points, to provide a more definite and more permanent barrier to vehicles and the occasional cow. There is no administrative justification for keeping the road open; managers can still walk up the dugway to reach the top.

Regional Significance

Because of comparatively recent disturbance, WBM is not qualified as a candidate for the northern Plateau RNA network. However, its unusually depauperate flora confers some scientific interest (and is probably not a result of grazing). Perhaps a subdivision of the mesa could be surveyed, some years hence, as a potential RNA after the road is more explicitly blocked off. In the meantime, the woodland typology on Wagon Box Mesa needs to be resolved. Once again, the area points out how coarse the applicable classifications are. Isolated or geologically unusual terranes are regularly yielding new expressions of pinyon-juniper vegetation.



Map II.11 Location and boundary of Wagon Box Mesa. Wagon Box Mesa 7.5' quadrangle. Photopoints 1605 and 1606 shown by "X".

Table II.16 Vascular plant species observed on Wagon Box Mesa, Capitol Reef National Park and the Escalante Resource Area of the BLM, on May 28, 1990.

Trees

Juniperus osteosperma
Pinus edulis

Shrubs

Amelancher utahensis
Artemisia bigelovii
Cercocarpus intricatus
Chrysothamnus nauseosus
Ephedra viridis
Eriogonum corymbosum
Eriogonum microthecum
Gutierrezia sarothrae
Purshia mexicana
Shepherdia rotundifolia

Grasses & Grass-Like Plants

Stipa hymenoides

Forbs and Cacti

Astragalus sp.
Chaenactis douglasii
Cymopterus purpureus
Echinocereus triglochidiatus
Eriogonum alatum
Helianthella microcephala
Hymenoxys acaulis
Lesquerella intermedia
Mahonia fremontii
Oenothera caespitosa
Pedicularis centranthera
Penstemon platyphyllus
Penstemon sp.
Petradoria pumila
Physaria acutifolia
Streptanthus cordatus
Swertia albomarginata
Yucca harrimaniae



Figure II.19 The pinyon-juniper woodland interior toward the northern end of the mesa. Stemless woollybase plants are the dominant forb here as on many acres throughout the mesa top.



Figure II.20 A woodland variant with virtually no understory. This can be considered a depauperate phase of the association in the preceding photograph, inasmuch as the same understory plants are still sparsely present.

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CEDAR BREAKS NATIONAL MONUMENT, UTAH

*

CEDAR BREAKS NATIONAL MONUMENT

Cedar Breaks National Monument (CBNM) contains 6154 acres, all in far southeastern Iron County, Utah. The squarishly-shaped unit is embedded in the Cedar City District of the Dixie National Forest, on the Markagunt Plateau. President Franklin Roosevelt proclaimed CBNM in 1933 "for the preservation of the spectacular cliffs, canyons and features of scenic, scientific and educational interest contained therein" (CBNM 1989: 4). Two boundary adjustments, in 1942 and 1961, added several hundred acres to the original monument.

Most of the monument's landscape consists of a "multicolored amphitheater eroded from the Pink Cliffs member of the Wasatch limestone" (CBNM 1989: 4). The Pink Cliffs stratum was deposited in shallow lacustrine environments about 55 million years ago. The height of the amphitheater is about 2,000 feet. On the encircling rim, Cedar Breaks has unusually vivid displays of subalpine wildflowers, and dense, often massive subalpine forests. Spruce-fir (Picea engelmanii-Abies lasiocarpa) communities of the Utah High Plateaus are well-typified here and on adjacent national forest lands. Forests of the amphitheater proper are drier and more "montane" in character.

The monument extends for about 4 miles north and south, and for 2.6 miles east and west. However, it appears appreciably larger to many visitors on the rim. Features in the bottom and the recesses of the amphitheater are often hidden from superior views, which are spectacular and far-ranging.

The Wilderness Subzone applies to 4830 acres in the monument, whereas the Natural Environment Subzone has 1233 acres. There is a small visitor center, a campground, a picnic area, and miscellaneous structures. These developments occupy a tiny fraction of CBNM's acreage. The rim is traversed by about 6 miles of winding, paved road with several viewpoint pullouts plus the Alpine Pond parking lot.

The most pertinent management objective (CBNM 1989: 13) for relict vegetation occurrences is: "To preserve the wildlife, spectacular cliffs, canyons, and other features of scenic, scientific, educational and cultural value within Cedar Breaks National Monument". An associated issue is that "there is insufficient information available about floral and faunal resources on which to base sound decisions in planning and management" (CBNM 1989: 13). Fortunately, a high proportion of the park's acreage, in both the Wilderness and Natural Environment subzones, is probably pristine. Bristlecone pine habitats are of particular note, as are individual trees hundreds of to nearly 2,000 years old. Some of the "breaks" endemic plant species mentioned in the Bryce Canyon writeups also occur within CBNM.

Livestock grazing influenced the rim of CBNM until about 1948, and had gone on for roughly 60 years before that. Although the subalpine meadows that the highway passes alongside are not pristine, recovery has been strong. The least disturbed places in CBNM are heavily forested and/or below the rim. Very few visitors explore the amphitheater or the forest's depths. Only the south and north peripheries of the amphitheater are served by trails, which do not reach the channels of Rattle, Arch, or Ashdown Creeks.

Catherine Jean, an associate of Dr. David Roberts at Utah State University, suggested the relict vegetation sites we surveyed in Summer 1990. She had been engaged in vegetation sampling and rare-plant mapping. The situation in Cedar Breaks is somewhat unusual for a Park System unit of the northern Colorado Plateau, inasmuch as the majority of the Wilderness Subzone is already a Research Natural Area. The Amphitheater RNA has 5230 acres. Although it appears in several directories, very little is known about it apart from the rest of the monument.

ALPINE POND SPRUCE

Introduction

"Alpine Pond Spruce" (APS) is one of two relict sites on the Cedar Breaks rim. It is also the monument's highest one (Map II.12). The site has large, predominately Engelmann spruce forests and lushly-vegetated subalpine meadows (Figures II.21 and II.22). It is near but does not include a well-marked and publicized monument feature, Alpine Pond. The site does not take in the trail around the pond nor the parking areas serving the trail. Natural-history exhibits alongside the trail, and the general setting, are described in a colorful brochure (Zion Natural History Association no date). The brochure does not mention any nearby "natural area" nor comment on the comparative massiveness of the spruce.

The first author inspected APS on July 7, 1990. He had first learned of and visited the site in Summer 1982. No detectable changes in vegetation or use levels had occurred during the intervening 8 years. A plant list was not compiled nor a photo station emplaced in 1990, due to lack of time and equipment (in use at Bryce Canyon).

Alpine Pond Spruce is a technically non-relict "special case". It completely lacks topographic barriers to human or livestock entry, and probably saw grazing before monument fencing and patrolling eliminated it for good. In any case, the forest typifies an association in our classification extremely well (Table II.1). This place certainly warranted a writeup.

Location and Size

Alpine Pond Spruce adjoins the rim of the Markagunt Plateau in southeastern Iron County, Utah. The undemarcated locality is north of Alpine Pond proper (Map II.12). (Alpine Pond drains to Rattle Creek in the amphitheater). The site is northwest of benchmark (BM) "10570" (Map II.12, which does not depict the Alpine Pond parking lot nor the Chessman Overlook). An arrow is used on the map to avoid obscuring features or implying that a definitive boundary survey was undertaken. Roughly 30 acres are involved. Restricting the area of discussion to rim lands is entirely arbitrary; much the same vegetal conditions prevail for some distance down the slopes of the amphitheater and thus into the old Research Natural Area (RNA).

Accessibility

The interior of APS is easily reached on foot, even with limited time. One may begin at Chessman or, more easily, a northern parking lot. From the Alpine Pond parking area (Zion Natural History Association n.d.), the best way in is to follow the trail to trail exhibit #4 or #8 and then to go directly north, cross-country. Alpine Pond Spruce lacks built or "social" trails, and has no public or service roads. Visual and auditory screening from the rim highway and the Alpine Pond Trail is very good. Walking within the area is easy because the terrain is gentle and there is little undergrowth (Figures II.21 and II.22).

Relict Character

The resilient plant communities of APS appear pristine. Evidence of gross man-caused or natural disturbances is lacking. The area was certainly never logged. It was, however, almost unquestionably grazed. Only herder practices, drift fences (none, however, were seen) and lack of forage under the trees would have limited the ingress of sheep. The meadows lack sign of

trampling or overutilization, and no bedgrounds were seen. The actual impacts may have been mild or transient, and in any case are impossible to reconstruct with certitude. The herbaceous communities are tantamount to "recovered".

Alpine Pond Spruce seemingly gets negligible visitation. There is no known, much less publicized, attraction within it. The same scenic attributes and natural-history points of interest can be enjoyed alongside or close to the Alpine Pond trail. Administrative developments do not occur in APS.

Geology and Terrain

The site's parent material consists of the uppermost exposures of the Pink Cliffs member. Rhyolitic tuffs mentioned in the Alpine Pond brochure do not outcrop here. Soils appear to be deep and high in organic matter. Community boundaries appear stable and very largely determined by soil saturation and its duration after snowmelt--the forest is better-drained.

Elevations within the area range from about 10,400 to 10,500 feet, depending on how much of the rim is considered (Map II.12). A "panel" of recognizably similar spruce forest descends at least 150 feet over the rim, and probably several hundred feet. Level, gently concave and hummocky surfaces all occur above the rim, whereas below it the terrain slopes as steeply as 100 percent on west, north and intermediate aspects.

Vegetation

The area supports two distinct, essentially nonoverlapping formations: coniferous forest and (montane) shrubland (Table II.1). The meadows are dominated by tall forbs, however, rather than by any conspicuously woody shrub (Figure II.22). Dr. Hayle Buchanan terms them "subalpine marshy meadows". Most openings are less than 1 acre in size and seem to share the same plants.

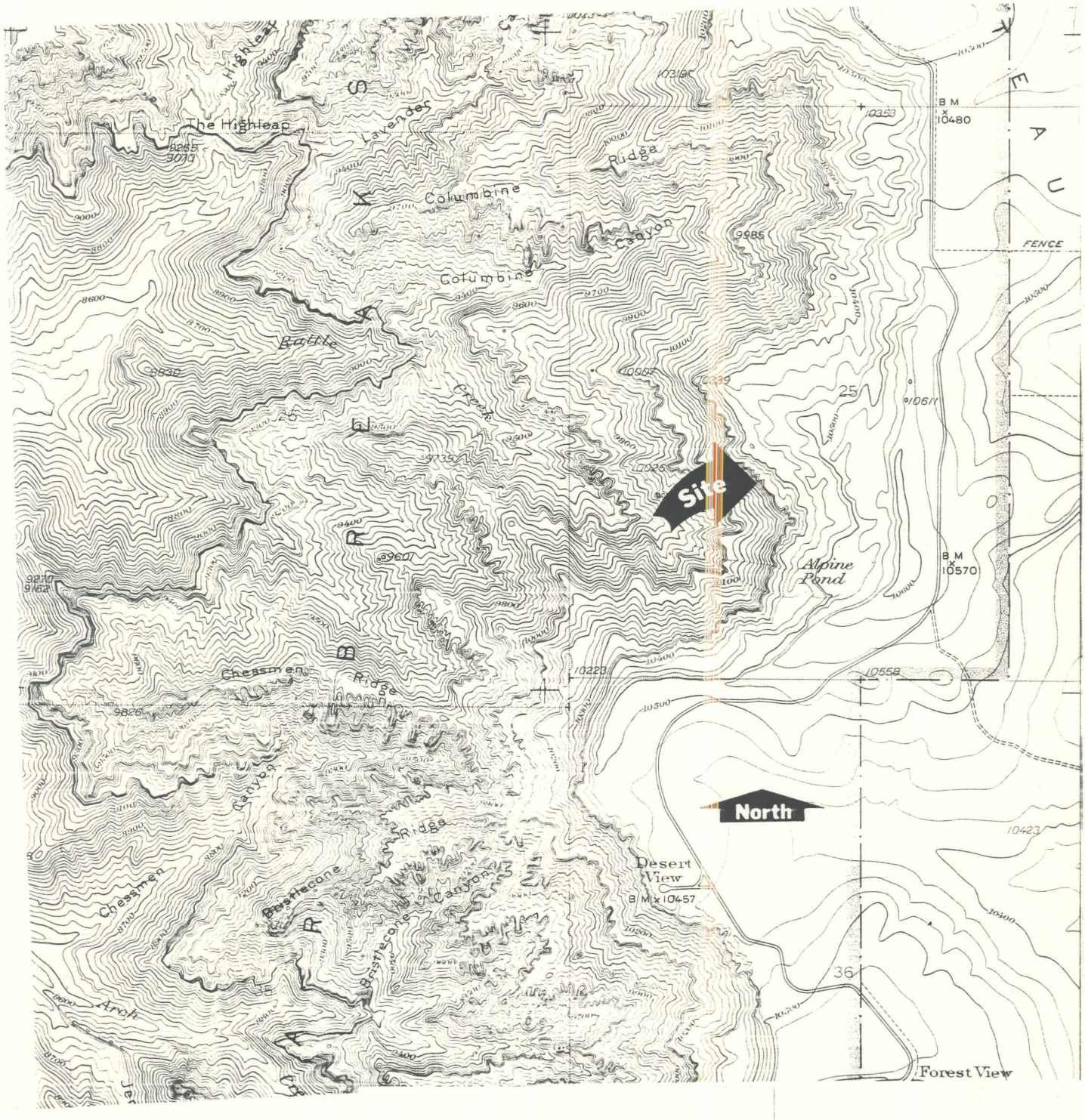
The forest is technically old-growth, and may be superlative in dimensions for its habitat type. There are deep, continuous duff and many fallen trunks including well-decayed ones. Snags do not comprise an appreciable fraction of the standing stems. The average maximum diameter, breast height, of the spruce is about 30 inches; the largest trunks are three feet in diameter (Figure II.21). The tallest trees are about 100 feet high; a few tops may reach 120 feet. Subalpine fir is a minor visual and ecological component of the forest; there are no dominant or codominant fir trees. Notably tall bristlecone pine are occasionally found in the forest's midst. The classification units present are:

1. **Abies lasiocarpa/Ribes montigenum (ABLA/RIMO), Thalictrum fendleri Phase.** Youngblood and Mauk (1985) use Mertensia arizonica to denote this moist subdivision.

2. **Lupinus argenteus Tall Forb (LUAR/TALL).** (Tentative addition to the classification).

Management as a Relict Area/Regional Significance

No particular measures appear necessary to protect APS's integrity nor to perpetuate its evidently stable communities. The site is too small for RNA status. Nonetheless, it "showcases" a superb forest habitat type example and has high regional importance. Alpine Pond Spruce's virtues are as much esthetic as scientific, and would interest the discerning photographer or dendrology enthusiast. The area can certainly withstand the occasional visitor and group, but its meadows are too fragile and damp for camping.



Map II.12 Location and setting of Alpine Pond. Monument map and Brian Head 7.5' quadrangle.



Figure II.21 The forest interior, showing live and dead specimens of some of the largest-diameter Engelmann spruce occurring within the area.



Figure II.22 The forest/meadow margin, showing the abundant subalpine fir deadfall, a live fir (upper center), and the luxuriant growth of tall forbs, chiefly silvery lupine.

BARTIZAN POINT

Introduction

Out along the Wasatch Ramparts is probably the most diversified site of the four inspected within the monument. Bartizan Point (BP) has both the deep spruce-fir forest of the rim and the open woodlands of the Breaks country. It also supports a species-rich meadow and a narrow streamside community. More variation is apparent in the tall forests here than within Alpine Pond Spruce.

Bartizan Point is situated on the southwestern extremity of the rim (Map II.13). It is bounded by very steep topography on its east, north and west sides, and by the monument boundary on the south. Bartizan Point technically adjoins "Shooting Star Ridge" (see next site writeup) on the rim north of The Bartizan, but the two places are reported separately in this volume. Travel between them is difficult and not obligatory.

Schelz, Van Pelt, and L. Nance (Native Plants Inc.) surveyed BP on July 8, 1990. We compiled a two-phase plant species list (Table II.17) and installed photo stations within the bristlecone/limber pine woodland and the main meadow (Map II.13). Figures II.23 and II.24, taken during intermittently stormy conditions, depict the forest, the rim boundary, and the stunted woodland. A frequency transect within the latter encompassed several of the southwestern Utah endemic plants, some of which are known from Bryce NP.

Location and Size

Bartizan Point is situated in eastern Iron County, Utah, in the southwestern part of Cedar Breaks NM. The area's southern boundary is one mile northwest of where the main road enters the monument boundary (Map II.13). (Signs on trees mark both the CBNM boundary and the south side of BP). Bartizan Point extends for about nine-tenths mile southeast-northwest, and from one-quarter to one-half mile from west to east. The boundary delineated on Map II.13 includes about 161 acres.

Accessibility

A well-marked, publicized, and frequently-used trail descends along the rim from Spectrum Point toward BP, but does not reach its boundary. There is a trailless section between the trail's end and an old fence (Map II.13). The trail winds pleasantly through meadows and spruce-fir forest before reaching some rather large and striking bristlecone pine trees. Beyond the trail, the edge of the rim is precipitious and caution is advisable (Figure II.23).

Relict Character

All of the area's vegetation appeared to be in pristine condition. The forest has never been logged, and it has probably always been too dense and lacking in forage for livestock. The timber also buffers the small meadowlands, which lack signs of grazing and trampling, or of exotic species.

Although BP is not far from visitor concentrations, we saw almost no sign of people within it or at the margins. An occasional visitor must wander down to the Bartizan for photography or views in solitude, but no defacto trail has resulted. Persons unknown (probably hikers seeking a secluded campsite with views) built fire rings along the area's streamcourse a little above its pouroff into Shooting Star Creek. There was no attendant trampling or cutting of vegetation, however. Other than the unmaintained fence, BP lacks Park Service structures. We obliterated the fire rings.

Geology and Terrain

The area's parent material consists of the Pink Cliffs, whose uppermost exposures are a few hundred feet lower than they are alongside Alpine Pond Spruce. Figure II.23 shows the substrate dramatically. The southern half of BP has a small valley (Figure II.23, left-center) with a low-volume perennial stream in the middle. The tall coniferous forest occupies moderate to steep slopes, alluvial soils are present in the low-gradient, nonstony drainageway, and the area's exposed periphery has barrens (Figure II.24). Changes from one terrain to the other occur within a few yards. The area has roughly 500 feet of vertical relief, from around 9300 to 9800 feet elevation.

Vegetation

The tall forest reflects the subalpine fir/mountain gooseberry habitat type, from its modal expression to the wetter phases such as Fendler meadowrue (the technical typology is supplied below). The forest is probably most massive along the center of the southern boundary. There and elsewhere occur Engelmann spruce and Douglas-fir of impressive dimensions. Subalpine fir are abundant beneath the canopy, much more so than within Alpine Pond Spruce. In places, Douglas-fir is a long-lived seral dominant. Patches of Mertensia arizonica indicate locally moister conditions, possibly hillside seeps.

Prominent herbaceous plant species along the shaded stream channel (less than 10 feet wide) include Cardamine cordifolia, Caltha leptosepala, Primula parryi, Geranium richardsonii, Equisetum laevigatum and E. arvense. On the barrens, Linum kingii and Lomatium minimum are hallmark herbs beneath the stunted pines (Figure II.24). Bartizan Point lacks massive, especially picturesque or (so far as is known) dendrochronologically interesting bristlecone trees. Types of the whole area appear to be:

1. **Abies lasiocarpa/Ribes montigenum (ABLA/RIMO)** (Both Thalictrum fendleri and Ribes montigenum phases).

2. **Abies lasiocarpa/Berberis repens (ABLA/BERE)** (Pinus flexilis phase). (More southerly slope aspects).

3. **Pinus flexilis-Pinus longaeva (PIFL-PILO) Series.**

4. **Picea engelmanii/Equisetum arvense (PIEN/EQAR).**

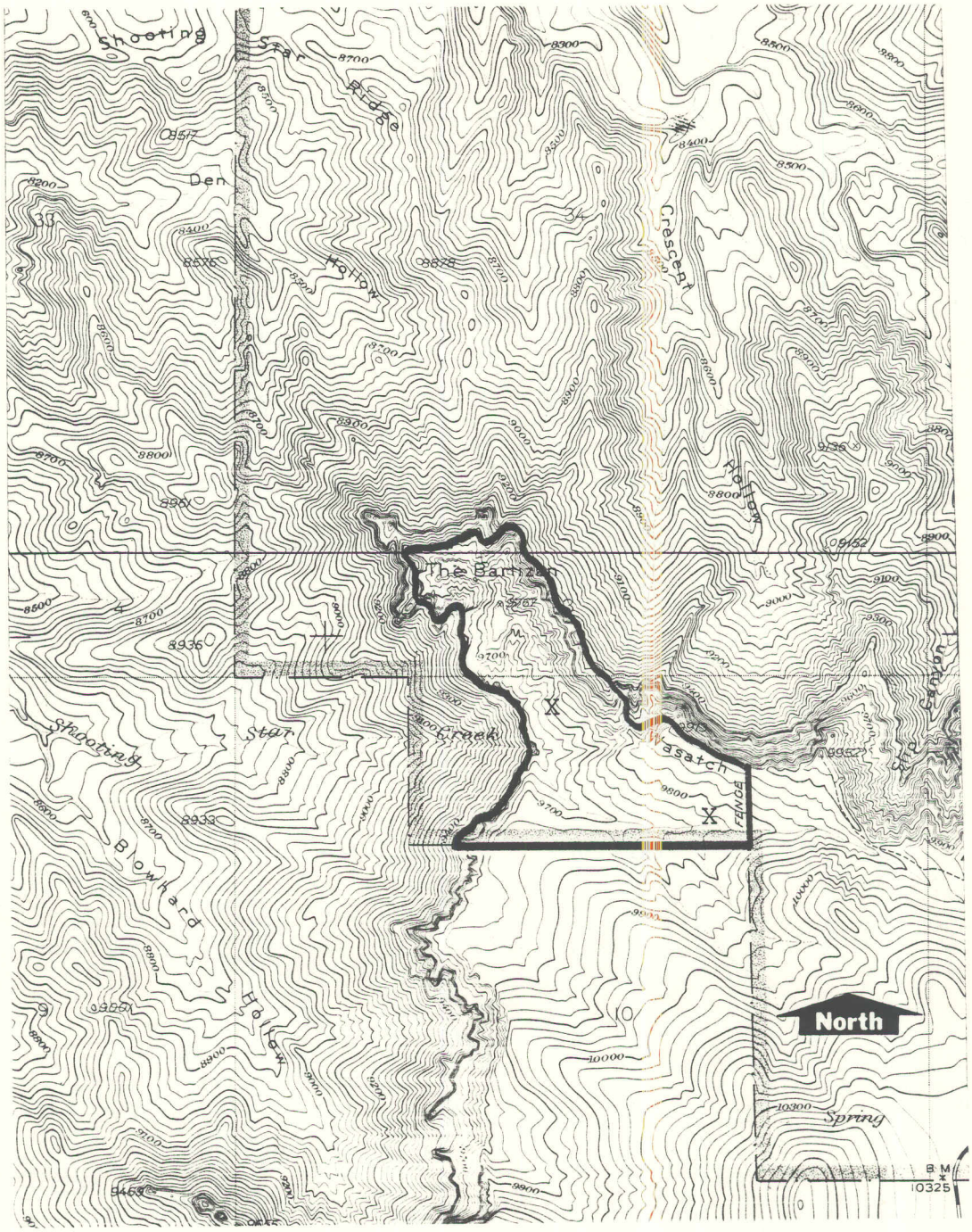
5. **Subalpine Marshy Meadows** (not in Table II.1).

Because it is fairly large and has diversified terranes, BP probably harbors other vegetation associations. And, here as elsewhere in southwestern Utah, the broad limber pine-bristlecone pine series could be further broken down.

Management as a Relict Area/Regional Significance

Bartizan Point is removed from visitor byways, shows no evidence of depreciation, and is subject to no foreseeable external threats. The Park Service has no plans for developments within the area. No actions are necessary to perpetuate the area's plant communities. Bartizan Point appears to support pristine conditions and to be a defensible RNA. It might be added to the existing one.

Bartizan Point contains no unique vegetation elements, but it is larger, mroe discrete and more remote than Alpine Pond Spruce. It exceeds the size minimum for an RNA, and the forest and meadow communities might be valuable for representation in the plateau-wide Research Natural Area network.



Map II.13 Location and boundary of Bartizan Point. Navajo Lake 7.5' quadrangle. Photopoints shown by "X".

Table II.17 Vascular plant species observed within Bartizan Point, Cedar Breaks National Monument, on July 8, 1990.

-- Meadow Area --

Trees

Pinus edulis
Populus tremuloides
Pseudotsuga menziesii
Salix sp.

Shrubs

Betula occidentalis
Ribes montigenum
Rubus idaeus
Symphoricarpus oreophilus

Grasses & Grass-Like Plants

Carex sp.
Calamagrostis scopulorum
Deschampsia caespitosa
Eleocharis palustris
Equisetum arvense
Equisetum laevegatum
Hordeum brachyantherum

Forbs and Cacti

Aconitum columbianum
Aquilegia caerulea
Agoseris glauca
Angelica pinnata
Aster sp.
Astragalus miser
Caltha leptosepala
Cardimine cordifolia
Castilleja linariifolia
Castilleja rhexifolia
Cirsium arizonicum

Forbs and Cacti

Cirsium calcarum var. *pulchellum*
Cymopterus lemmonii
Delphinium barbeyi
Epilobium angustifolium
Euphorbia robusta
Fragaria virginiana
Geranium richardsonii
Habanaria sparsiflora
Helianthella uniflora
Lithospermum multiflora
Mertensia ciliata
Osmorhiza depauperata
Pachystima myrsinites
Pedicularis groenlandica
Pedicularis parryii
Penstemon spp.
Phlox pulvinata
Plantago tweedyi
Primula parryi
Pyrola asarifolia
Ranunculus alismaefolius
Ranunculus eschsholtzii
Saxafragus odontoloma
Senecio atratus
Senecio multilobatus
Shepherdia canadensis
Smilacina stellata
Solidago sparsiflora
Swertia radiata
Thalictrum fendleri
Trifolium longipes
Viola canadense
Zygadenus elegans

(continued)

(Table II.17, continued)

-- Breaks Area --

Trees

Juniperus communis
Pinus flexilis
Pinus longaeva

Shrubs

Chrysothamnus viscidiflorus

Grasses & Grass-Like Plants

Stipa comata
Stipa hymenoides

Forbs and Cacti

Aquilegia scopulorum
Arenaria fendleri
Astragalus kentrophyta
Cirsium arizonicum
Cymopterus lemonii
Cymopterus minima
Eriogonum panguicense
Geranium richardsonii
Hymenopappus filifolius
Lesquerella rubicundula
Linum kingii
Lomatium minimum
Mahonia repens
Oxytropus oreophyla
Pachystima myrsinites
Senecio multilobatus
Townsendia montana var. *minima*



Figure II.23 The Bartizan, viewed from one of the overlooks near the Cedar Breaks Visitor Center. The abrupt change from well-developed forest to virtually unvegetated Breaks terrain is quite evident here.

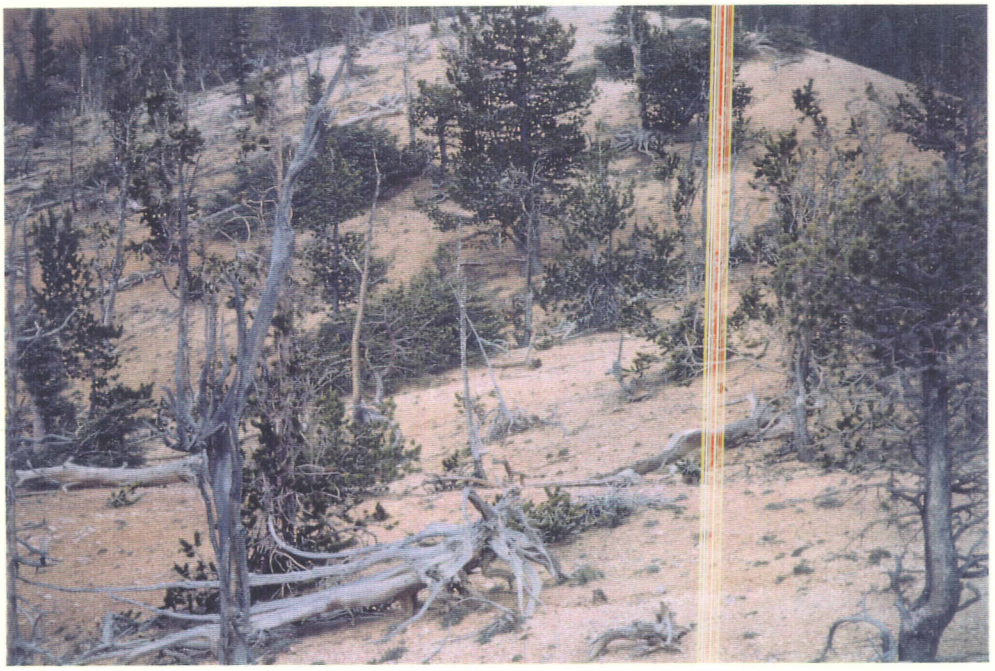


Figure II.24 The locale of the second photopoint and the frequency transect. Limber pine occur here, as well as the dominant bristlecone pine. Prominent understory species include *Aquilegia scopulorum* and *Linum kingii*.

SHOOTING STAR RIDGE

Introduction

The area reported here comprises the main block of continuous forest south of Ashdown Creek (Map II.14, upper center) and below the rim. "Shooting Star Ridge" (SSR) may be considered a northern and dramatically lower extension of Bartizan Point (Map II.14, lower center). The area takes in the eastern limb of Shooting Star Ridge (which extends onto the national forest) and the elevational span of the amphitheater in this part of the monument. The survey area is fully visible from Point Supreme. It is the most arbitrarily bounded and least satisfactory of the Cedar Breaks prospects.

Schelz and Van Pelt hiked through Bartizan Point on July 10, 1990 before descending into and surveying SSR. We compiled a doubtlessly incomplete plant species list (Table II.18) and set up one permanent photo station (Map II.14; Schelz and Van Pelt 1990). Our survey was rather rapid and extensive, given the area's size and steepness. We defined the boundary from above afterwards.

Location and Size

Shooting Star Ridge is situated in southeastern Iron County, southwestern Utah. It falls within the west-central sector of the monument, south of the axis of the amphitheater. The northern boundary is the south bank of Ashdown Creek, whose channel holds no vegetational interest. On the east and southwest sides of the area, the boundary follows descending ridgelines. On the northwest, it coincides with the monument boundary; on the south, it follows the base of the cliffs below Bartizan Point. Substantially the same terrain, vegetation and land-use circumstances may occur on contiguous national forest lands, some of them in a classified Wilderness.

Shooting Star Ridge extends for about 1.6 miles north and south, and is about seven-tenths mile wide (Map II.14). Our rather conservative boundary line takes in roughly 623 acres or the equivalent of about one square mile.

Accessibility

Initial hiking directions for an approach from above are the same as for Bartizan Point. Virtually all of the rim is precipitous (Figure II.25). The only feasible descent without technical climbing gear seems to be a little short of The Bartizan, via a rubbly chute. For agile and careful hikers only, this leads down onto Shooting Star Ridge (Figure II.26), where the going is easier albeit somewhat obstructed by undergrowth. The area proper is entirely roadless and trailless. Movement within it on foot is slow. To return to the vicinity of The Bartizan, we ascended Crescent Hollow Creek before swinging southwest to re-enter the boundary and negotiate the access chute. Much of the area's north half could be reached via Ashdown Creek, but the channel is fronted by steep, timbered bluffs that repel direct or easy entry.

Relict Character

Past grazing is quite unlikely, and we saw no signs of logging or fuelwood cutting. Cultural evidence, including stock facilities, was likewise not detected. However, we could not survey all of the area, and its dense growth might conceal historic structures. We reserve judgement on whether SSR everywhere supports relict vegetation. It may, but topographic barriers are lacking and there are certainly more remote pieces of the amphitheather. Signs of fire are abundant, even though no recent burns are apparent. We think that most fires amply predate the monument's establishment, and were set

by lightning or Indians. Signs of modern-day visitors are missing.

Geology and Terrain

The entire area is underlain by the Pink Cliffs member of the Wasatch Formation. Site differences from place to place are influenced by slope steepness, aspect and, probably, fire history. Gross subdivisions of the area are ridgetops, canyonbottoms and slopes facing in nearly all directions except south (Map II.14). About two-thirds of the top of physiographic Shooting Star Ridge is included. The area is rather densely and almost wholly forested (Figure II.25). Elevations range from about 8200 feet alongside Ashdown Creek to 9300 feet at the cliffbase under The Bartizan.

Vegetation

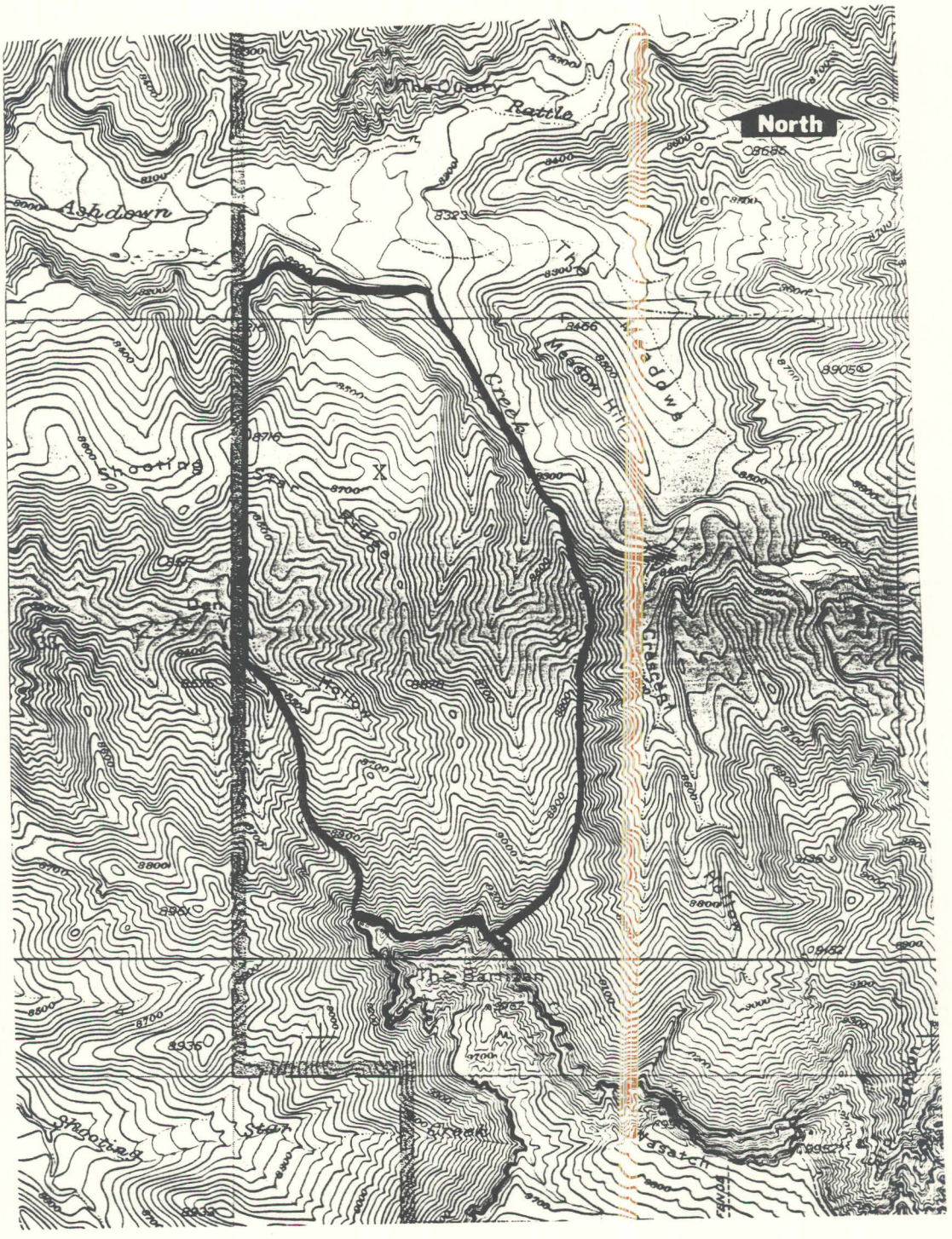
The forest overstory is a complex and continuously varying mixture of white fir (Abies concolor), limber pine, Douglas-fir, blue spruce, and ponderosa pine (Figures II.25 and II.26). These coniferous stands are irregular in structure, are rarely pure (one-specied), and grow on rather low-quality (noncommercial) sites. Indicative understory shrubs in order of abundance are Arctostaphylos patula, Juniperus communis, Berberis repens, Ceanothus sp., and Shepherdia canadensis. There seem to be no unusual forest herbs nor southwestern Utah endemic plants (Table II.18). Greenleaf manzanita is prominent on ridges and slopes, forming large clumps (Figure II.26). Regeneration of white fir is generally profuse, possibly indicating a fairly long interval (decades) since the last sizeable fire. Surprisingly, no curl-leaf mountain mahogany are present despite the dry slopes and thin soils. Classification units present appear to be (from greatest to smallest areal extent):

1. **Abies concolor/Berberis repens (ABCO/BERE), Pinus flexilis phase.**
2. **Abies concolor/Arctostaphylos patula (ABCO/ARPA).**
3. **Pseudotsuga menziesii/Arctostaphylos patula (PSME/ARPA).**
4. **Picea pungens/Juniperus communis (PIPU/JUCO).**
5. **Picea pungens/Equisetum arvense (PIPU/EQAR)** (Probable).
6. **Abies lasiocarpa/Acer glabrum (ABLA/ACGL)** (Probable).

The area doubtless has microhabitats and may support limited occurrences of aspen (Populus tremuloides) community types, probably seral to conifers. Essentially no treeless vegetation is present; some small "brushfields" will probably revert to ponderosa pine and Douglas-fir dominance. An exhaustive list of associations, and a vegetation mosaic map, would require a several-day survey. Bristlecone pine are scattered and incidental in occurrence.

Management as a Relict Area/Regional Significance

No explicit measures seem to be necessary to perpetuate the current, undisturbed conditions of this area. Visitation impacts are immaterial in such a dry, steep, trailless part of the monument, but there is a small perennial risk of an accidental ignition from a campfire or match. Park Service developments are already constrained by RNA status. No unique or regionally essential vegetation types appear to be present; those that may be are automatically represented in the inclusive Amphitheater RNA.



Map II.14 Location and boundary of Shooting Star Ridge. Brian Head and Navajo Lake 7.5'. quadrangles. Photopoint 1618 shown by "X".

Table II.18 Vascular plant species observed within Shooting Star Ridge, Cedar Breaks National Monument, on July 10, 1990.

Trees

Abies concolor
Acer glabrum
Juniperus communis
Picea pungens
Pinus flexilis
Pinus longaeva
Populus tremuloides
Pseudotsuga menziesii

Shrubs

Arctostaphylos patula
Brickellia microthecum
Ceanothus martinii
Cercocarpus ledifolis
Chrysothamnus viscidiflorus
Purshia tridentata
Ribes cereum
Rosa woodsii
Rubus idaeus
Sambucus caerulea
Symphoricarpus oreophilus

Grasses & Grass-Like Plants

Calamagrostis scopulorum
Hilaria jamesii
Poa fendlera
Stipa comata
Stipa hymenoides

Forbs and Cacti

Achillea millifolium
Antennaria rosulata
Apocynum androsaemifolium
Arabis drummondii
Arenaria fendleri
Aster chilensis
Astragalus kentrophyta
Calochortus nuttallii
Castilleja rhexifolia var. *rhexifolia*
Cirsium arizonicum
Cirsium calcareum var. *pulchellum*
Clematis ligustifolia
Descurainia richardsonii
Draba subalpina
Epilobium angustifolium
Erigeron sp.
Eriogonum umbellatum
Euphorbia robusta
Fragaria virginiana
Geranium richardsonii
Gilia aggregata
Hymenopappus filifolius
Linum aristatum
Lithospermum multiflorum
Lotus utahensis
Mahonia repens
Pachystima myrsinites
Penstemon eatonii
Penstemon leiophylous
Pyrola secunda
Senecio multilobatus
Shepherdia canadensis
Swertia radiata

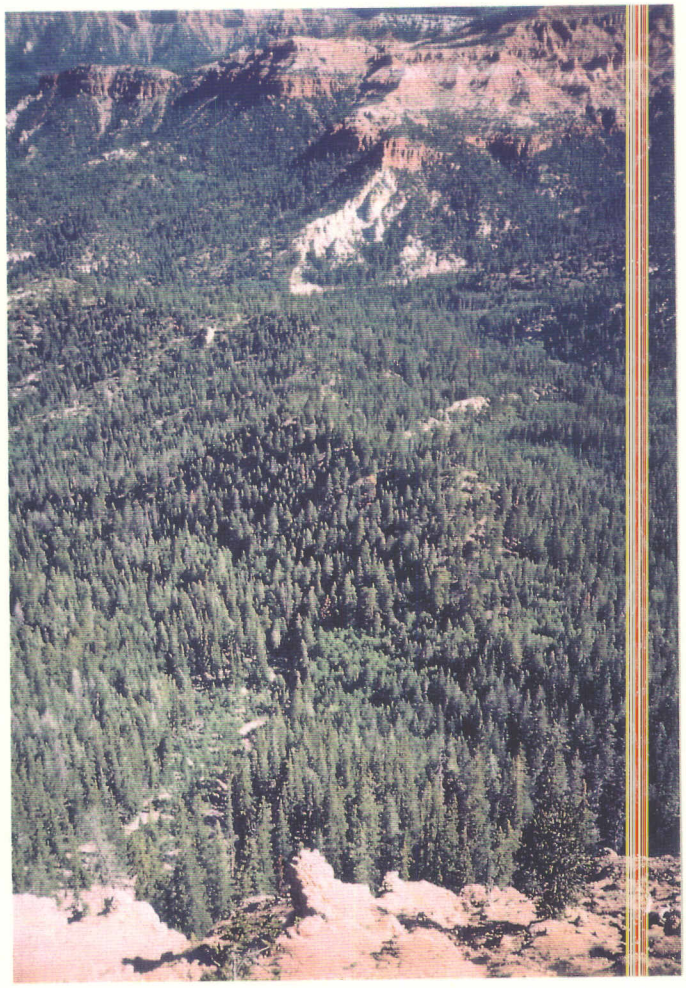


Figure II.25 The forests of the the eastern half of the area, seen from a point several hundred meters east of the prow of The Bartizan.



Figure II.26 A ridgetop mixed-conifer stand, containing white fir, ponderosa pine, and Douglas-fir. White fir saplings, greenleaf manzanita, and bitterbrush make up the undergrowth, which is thick enough to impede passage.

TRI-STORY CANYON

Introduction

The last area surveyed in 1990 was suggested by Catherine Jean. Tri-Story Canyon (TSC) occupies anomalously gentle terrain in the monument's northwest corner (Map II.15). The area features a bristlecone pine woodland with its typically interesting plant life (Graybosch and Buchanan 1983; Table II.19) and engaging scenery (Figures II.27 and II.28). As such, TSC is more similar to, and more readily compared with, Bryce Canyon NP and Dixie NF "breaks" areas than are the other three relict prospects in Cedar Breaks NM. Tri-Story Canyon is genuinely relict, but as an RNA it would embody a good deal of redundancy with types already protected in, for example, the Table Cliff Research Natural Area.

Schelz and Van Pelt surveyed TSC on July 9, 1990. We compiled a plant species list (Table II.19), and installed a photo station bearing the tag number of 1617 on the area's west-central side (Map II.15; Schelz and Van Pelt 1990). No visitors were encountered during the day, nor footprints seen.

Location and Size

Tri-Story Canyon is located in eastern Iron County, southwestern Utah. Topographically, it lies between and partly includes Snow Ridge and Adams Barrier. Tri-Story Canyon proper is an intermittent drainage that is not a tributary to one of the big creeks of the amphitheater. The area's southern boundary is about one mile north of the northern edge of Shooting Star Ridge. The whole area is readily comprehended from the western extremity of Snow Ridge. Correlation of features with the map is easy, except for interpolating the monument boundary. Tri-Story Canyon extends for about seven-tenths mile north and south, and for about one-half mile east and west. The boundary line shown on Map II.15 includes about 226 acres.

Accessibility

The Rattlesnake trail begins right along the monument's north boundary, just off the road to Brian Head (Map II.15, upper right). The trail goes west along or just outside the boundary, descending quickly northeast of Snow Ridge. The ridge can be gained by traversing upward from where the trail follows the contour in dense forest. About one hour and 10 minutes are needed to reach TSC's edge from the roadside parking area, and the inbound or outbound trip is not arduous. The area is well-screened from the trail, so its passage to the north has no current bearing on TSC's integrity. Travel within the boundary is easy enough, but frequently slowed by uneven and rocky ground.

Relict Character

Our survey revealed absolutely no sign of recent or historical human disturbance. The area clearly lacks, and has always lacked, economic resources or livestock forage. No signs of recreational abuses were noted. No monument developments are present. Pristine conditions can be documented elsewhere on this kind of terrain, so the relict character of TSC is not unique.

Geology and Terrain

The area has the same geology as the rest of the amphitheater, but with its gentle terrain quite resembles the landscapes of Bryce Canyon (see site writeup for Bristlecone Point, pages 35-39). Although compact, TSC has all these attributes of the Cedar Breaks amphitheater: recessed headwalls cut well back in the Wasatch Formation; cobbly channels with blue spruce; panels of fairly dense coniferous forest; mid-slope, open, mixed-conifer woods with Juniperus communis and Arctostaphylos patula in the understory; and stunted bristlecone and limber pine woodland on gentle terrain, including ridgetops (Figure II.27). Snow Ridge, however, is probably unduplicated anywhere in the monument in terms of coloration and flora (Figure II.28).

Vegetation

The main wash of Tri-Story Canyon is about 100 feet wide, with a largely barren, braided, rough channel. Blue spruce and limber pine populate the shifting creekbed. Some of its more stabilized "islands" support blue spruce saplings and a variety of shrubs and forbs, notably Monardella. Toward the canyon's narrowing head, the slopes are barren save for a few flaglike blue spruce.

Hillsides support a mixture of scraggly limber pine, blue spruce, and bristlecone pine with abundant common juniper and greenleaf manzanita. This "type" intergrades strongly with the bristlecone pine barrens. Those support the characteristic suite of regional endemics such as Linum kingii and Aquilegia scopulorum. The terrain's appearance is one of exceptional harshness, but it is rather well vegetated with both "rare" plants and the common shrubs. Linum kingii and Lomatium minimum are especially prominent, whereas other species are more discontinous in occurrence. Nominally a "barren", Snow Ridge's flora emphasizes other rarities (Figure II.28), as well as some highly picturesque bristlecone trees.

What we termed "north-slope forests" are akin to those of Shooting Star Ridge. The overstories consist of white fir, limber pine, Douglas-fir, and blue spruce. Common juniper, greenleaf manzanita, Pachistima myrsinites, and Berberis repens populate the open understories, along with Douglas-fir and white fir reproduction. These more or less isolated areas of "tall" forest are linked to the more xeric, open ones by limber pine and common juniper in particular. The "breaks" endemics are excluded by duff on the forest floor.

The series and associations present in Tri-Story Canyon appear to be:

1. **Abies concolor/Arctostaphylos patula (ABCO/ARPA).**

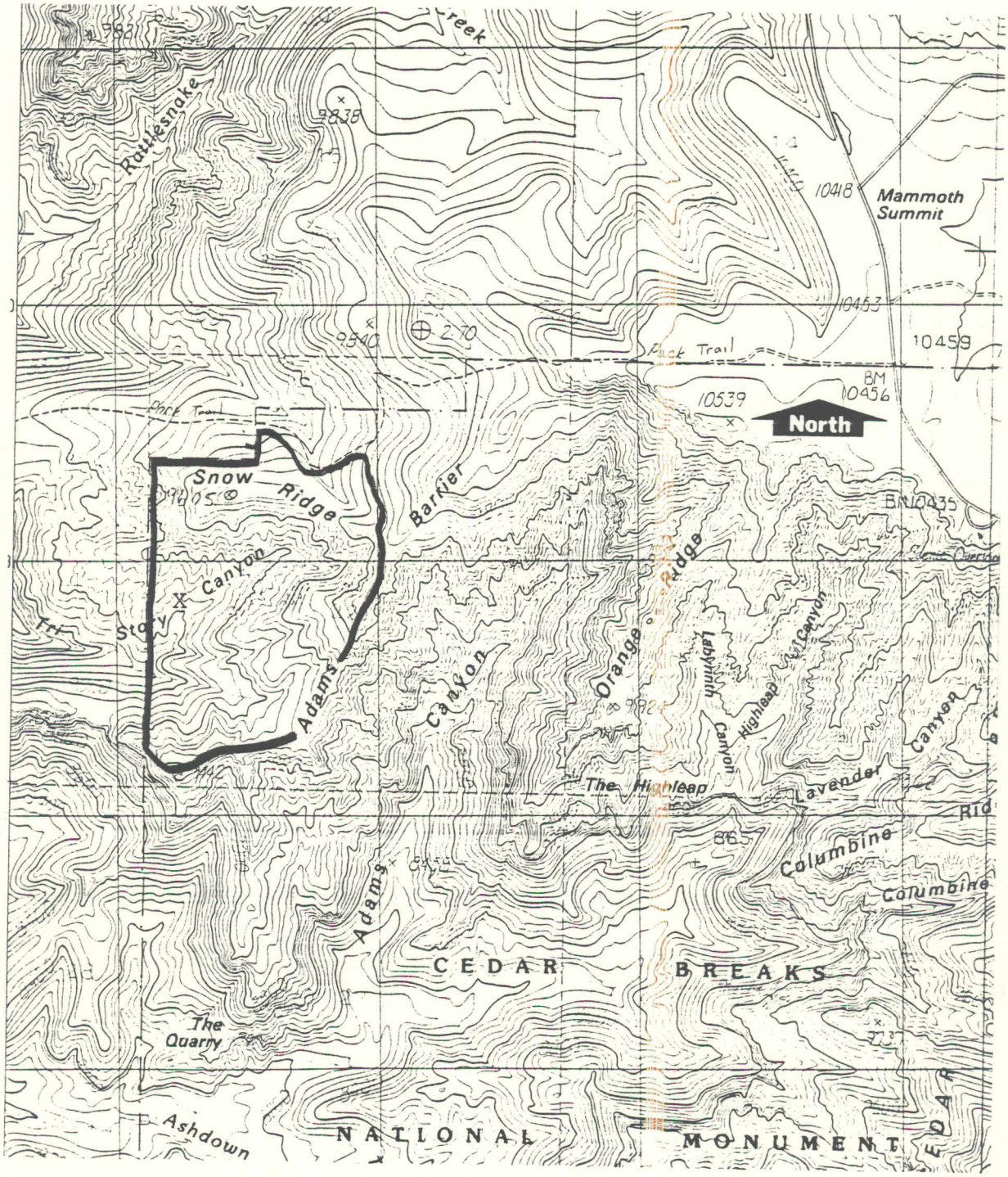
2. **Picea pungens/Juniperus communis (PIPU/JUCO).**

3. **Pinus flexilis-Pinus longaeva Series (PIFL-PILO).**

In addition, the area may support some of the coniferous associations (habitat types) noted within Shooting Star Ridge. However, closed-canopy forests in TSC are really much more discontinuous, and in smaller stands, than within that larger area. Using the habitat-type key in TSC was a rather inconclusive procedure. Any observation vantage falls within the broadly overlapping distributions of a host of normally denominating species like Berberis repens. Even more than bristlecone pine, blue spruce was ubiquitous throughout the day -- in all sizes, shapes, abodes, and degrees of dominance. Snow Ridge is a memorable and precious feature, and perhaps a fragile one.

Management as a Relict Area/Regional Significance

The Park Service need do nothing to protect the area from external threats or visitation impacts, except to prevent defacto trails from developing on Snow Ridge. Much of the area is quite fireproof, given the widely-spaced trees and shrubs and the sparse ground fuels. Tri-Story Canyon is easily managed as a relict area, and is probably within the Amphitheater RNA. Because of that, and because of TSC's similarity to other RNAs in Garfield County, we do not recommend formal designation nor placing this area in the northern Plateau network apart from the existing RNA. It could be slightly expanded if TSC lies outside it.



Map II.15 Location and boundary of Tri-Story Ridge. Brian Head 7.5' quadrangle. Photopoint 1617 shown by "X".

Table II.19 Vascular plant species observed within Tri-Story Canyon, Cedar Breaks National Monument, on July 9, 1990.

Trees

Acer glabrum
Juniperus communis
Picea engelmannii
Pinus flexilis
Pinus longaeva

Shrubs

Arctostaphylos patula
Chrysothamnus viscidiflorus
Eriogonum corymbosum
Potentilla fruticosa
Ribes cereum
Symphoricarpus oreophilus

Grasses & Grass-Like Plants

Bromus inermis
Calamagrostis scopulorum
Elymus spp.
Stipa comata
Stipa hymenoides

Forbs and Cacti

Aquilegia scopulorum
Arenaria fendleri
Aster chilensis
Astragalus kentrophyta
Castilleja parvula var. *parvula*
Cirsium arizonicum
Cymopterus lemonii
Cymopterus minima
Draba subalpina
Epilobium angustifolium
Erigeron sp.
Eriogonum panguicense var. *alpestris*
Euphorbia robusta
Geranium richardsonii
Hymenopappus filifolius
Ivesia scabulosa
Lesquerella rubicundula
Linum aristatum
Linum kingii
Lithospermum multiflorum
Lomatium minima
Macheranthera grindeloides
Mahonia repens
Monardella odoratissima
Oxytropus oreophila
Pachystima myrsinites
Pyrola secunda
Ranunculus alismaefolius
Senecio multilobatus
Shepherdia canadensis
Solidago sparsiflora
Townsendia montana var. *minima*
Tragopogon dubius

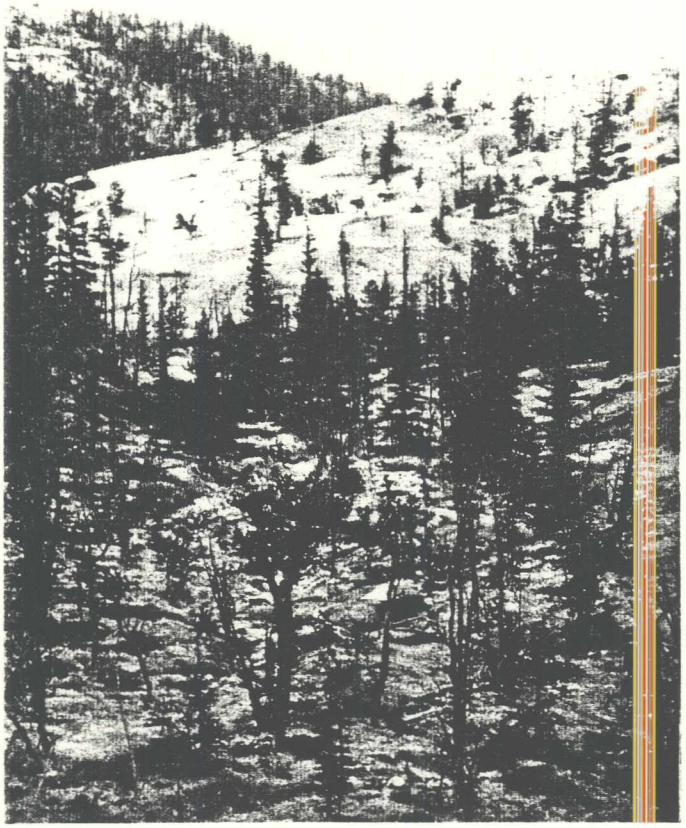


Figure II.27 A bristlecone pine woodland in one of the intermittent channels tributary to the canyon bottom. The location of the photo station lies on the opposite slope, above the picture's center.



Figure II.28 Snow Ridge, looking east. The most common plants between the trees and the dropoff on the right side are *Ivesia sabulosa*, *Arenaria fendleri*, and *Erigeron panguicense*.

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ZION NATIONAL PARK, UTAH

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ZION NATIONAL PARK

Zion National Park (ZNP) consists of 146,551 acres in southwestern Utah, within 15 miles of the state's border with Arizona. Zion was enlarged and renamed in 1919, after being proclaimed as Mukuntuweap National Monument in 1909. The park has two sections: Zion proper and the Kolob, which extends to the northwest. The park is mainly situated in Washington County, Utah, with small extensions into Kane and Iron counties. The boundary includes about 3800 acres of privately-owned land. The Wilderness Subzone takes in 131,104 acres.

The monument was expanded and renamed to protect "unusual archeological, geologic, and geographic interests" and to afford visitor enjoyment of scenic grandeur (ZNP 1989: 4). Zion lies on the western end of the northern Colorado Plateau. The southernmost part of the Markagunt Plateau (where Cedar Breaks is situated) and the western and southern edges of the Kolob Terrace are included. Zion's topography largely consists of imposing plateaus with receding cliffs that overlook deep canyons. Triassic and Jurassic strata are superbly exposed, especially the Navajo Sandstone. The Navajo is about 2,000 feet thick, and is much more prominent here than in any Park System unit of the northern Plateau.

The park's Statement for Management (ZNP 1989: 8) describes the ecological setting thusly:

> Characterizing the lower elevations are such plants as creosote bush [Larrea tridentata], mesquite [Prosopis sp.], blackbrush [Coleogyne ramosissima], and cholla cactus [Opuntia sp.]; while the higher plateaus support stands of Douglas-fir, white fir, blue spruce, and aspen. In between is a wide variety of plant life with varying adaptations, such as cottonwood, ash [Fraxinus sp.], and box-elder of the riparian habitat; the pinyon-juniper pygmy forest of the talus slopes and mesa tops; and sagebrush and scrub oak associations phasing into stands of ponderosa pine...The plateau is dissected by numerous steep and narrow canyons where there is sufficient shade and moisture to invite montane...vegetation [at these] lower elevations. Conversely, some species more typical of the desert may be found on dry, exposed sections of the plateau top. Hanging gardens drape the canyon walls in places where water, seeping through porous sandstone, keeps them permanently wet...

Zion encompasses nearly one mile of vertical relief, from approximately 3700 to 8700 feet.

A well-known park with a notably pleasant climate, ZNP is not far from major metropolitan areas and international airports where tourists disembark. Many visitors arrive from Europe and east Asia. For urban dwellers of Utah's Wasatch Front, Zion is a very popular, 'traditional' spring destination. The park's reputation and visitation levels have been enhanced in recent years by the residential and retirement boom in and around St. George. The town is the seat of Washington County and is about 25 miles southwest of the park.

About 90% of all visitors use 25 miles of the park's highways, causing some congestion and air pollution. Over 1 million hikers and horseback riders take Zion's 26 miles of trails, whose maintenance is falling in arrears. Given these levels of use, any purely natural areas in the park often directly abut or overlook facilities and visitor concentrations. Sites may be locally jeopardized by trampling, collecting, abusive camping practices, or vandalism. Fortunately, the best relict areas are guarded by sheer cliffs.

External (generally industrial or commercial) threats that park managers perceive are (ZNP in preparation):

Coal-fired power plants and ancillary strip mining.

Oil and gas development and uranium exploration on the park's northern and western boundaries.

Dam proposals upstream from ZNP.

Exploitation of the Kolob coal field to the north and east.

Like Cedar Breaks, Zion contains Research Natural Areas. A new one is under active administrative consideration for Parunuweap Canyon (ZNP 1992). The existing RNAs and their acreages are:

Bighorn (4760)
Kolob Mesas (500)
West Rim-Phantom Valley (15,360)

Zion's biota has received a good deal of research attention over the years, partly based on the themes of "island" topography (mesas) and moist plant refugia (hanging gardens). For isolated parcels of the plateau, Mason and West (1970) and Madany and West (1984) are illustrative and often-cited studies. The third author (Tuhy) participated in vegetational and botanical surveys contracted out to Brigham Young University (Harper and others 1988). (However, rare-plant inventories and mapping have not yet been performed on most of the free-standing mesa summits).

The plant communities above the unscalable escarpments constitute an extraordinary scientific resource. Their summits are as large or larger than those of mesas in parks like Canyonlands, and the effective environments are moister. Here are mountain-brush (Mason and West 1970), ponderosa pine (Madany and West 1984) and Douglas-fir or white fir (Youngblood and Mauk 1985) habitat types, as well as the pinyon-juniper more characteristically associated with mesa tops of the Colorado Plateau parks.

The park management objectives most pertinent to relict vegetation and the places where it occurs are (ZNP 1989: 21):

> [Natural Resource Conservation] To the degree possible, to restore and perpetuate the native plant and animal life and natural evolutionary forces that existed prior to disturbance by European man.
>
> [Data Base Collection] To secure, through research or other means, adequate information to perpetuate the park's natural resources, preserve its cultural resources, and provide diverse opportunities for environmentally compatible public use of the park.

The third author generated the list of relict-area prospects for Zion and had to use a helicopter to survey all but one of the sites reported below. No doubt pristine vegetation occurs on smaller mesas and pinnacles as well as on many canyonsides, but the following narratives clearly cover the largest, best, and most-studied sites in both the Zion and Kolob sections.

6665 MESA

Introduction

An unnamed mesa is located on the east side of the Narrows, about one-half mile north of Wynopits Mountain (Map II.16). "6665 Mesa" (6M) is named after its highest point, in the north-central part of the landform. The same point appears as 6657 feet on the 1:31,680 park map. No information existed about the mesa's features until the third author surveyed it in July 1988. Unlike the other Zion sites reported in this volume, 6M can be reached with hiking and scrambling. The route presumably allows deer to reach the summit plateau, also. The top supports coniferous forest and woodland vegetation in pristine condition (Figures II.29 and II.30).

Location and Size

The mesa is situated in east-central Washington County, Utah. It lies on the east side of the Narrows, about 3.2 miles north of the Temple of Sinawava (Map II.16). The summit of 6M extends for about eight-tenths mile northwest-southeast, and is around one-half mile across at its widest point. The boundary shown on Map II.16 includes about 143 acres.

Relict Character

The area's relict quality is excellent. It is accessible to deer, but certainly not to domestic livestock or vehicles. No signs of historic uses or vistation impacts were noted. No natural catastrophes have affected the vegetation.

Geology and Terrain

The Navajo Sandstone is exposed over the entire top of 6M (mesas in Zion can be capped by the Navajo, the overlying Carmel, or in a few instances by both). The topography consists of gentle slopes toward the rim, low knolls, and swales (Figures II.29 and II.30). Coniferous stands are restricted to more northerly aspects (Figure II.30). The area embodies a little over 400 feet of vertical relief. With predominately western and southern exposures, 6665 Mesa is one of the drier sites surveyed in Zion. Accordingly, pinyon-juniper woodland and oakbrush are prominent (Figure II.29).

Vegetation

The mesa top supports undisturbed, somewhat intergrading communities of white fir, Gambel oak, oakbrush, and pinyon-juniper woodland. Oak, juniper, pinyon, and true mountain mahogany (Cercocarpus montanus) commingle over appreciable areas (Figure II.29). Series and associations present appear to be:

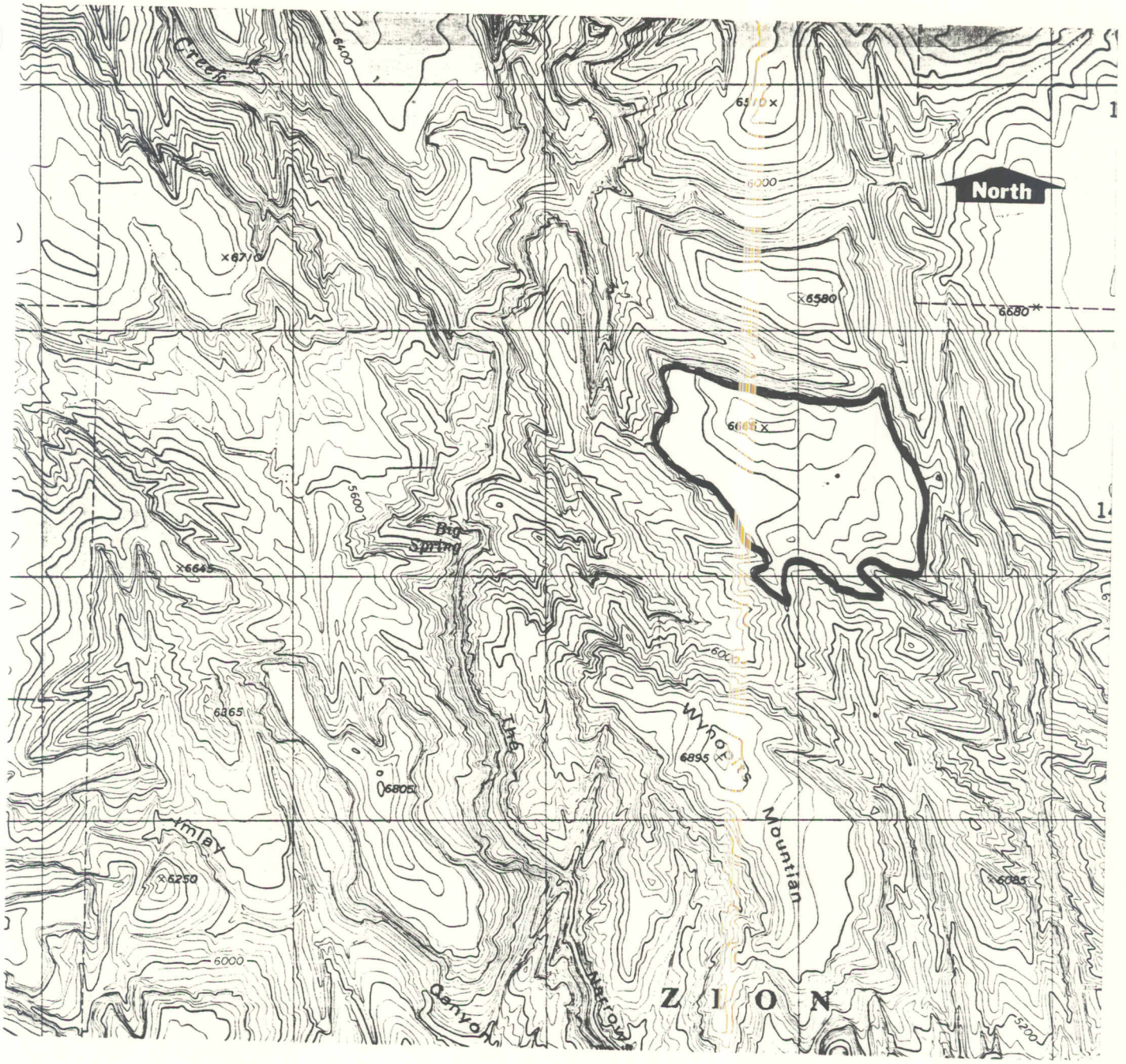
1. Abies concolor/Berberis repens (ABCO/BERE), Berberis repens phase.
2. Quercus gambelii (QUGA) Series.
3. Cercocarpus montanus (CEMO) Series.

4. Pinus edulis/Amelanchier utahensis (PIED/AMAL). (Manzanita (Arctostaphylos) is abundant in the understory).

In addition, an uncorrelated grassland association association is present on 6M. Abundant species include Poa fendleriana, Cirsium wheeleri (?), Opuntia macrorhiza, Eriqeron reliqiosus, Balsamhoriza saqittata, and Chrysothamnus viscidiflorus. This has apparently poor or negligible representation outside of Zion National Park.

Management as a Relict Area/Regional Significance

Manageability of 6665 Mesa as a relict vegetation site would be excellent. This is a well-defined, unpublicized area whose difficult access would preclude virtually all potential use- or management-related conflicts. The mesa is not within an existing RNA, so if its designation as such can be justified it would be an addition to the regional RNA network. Its greatest contribution would likely be a "new" grassland type not accounted for in our classification.



Map II.16 Location and boundary of 6665 Mesa. Temple of Sinawava 7.5' quadrangle.



Figure II.29 Woodlands of pinyon-juniper and oak are predominant on 6665 Mesa above The Narrows.



Figure II.30 An immature, mainly evenaged stand of white fir occupying the white fir/Oregon grape habitat type. *Geranium viscosissimum* appears here as the larger, spreading plant.

CHURCH MESA

Introduction

With three arms and several rim embayments, Church Mesa (CM) is the largest and most planimetrically complex of the relict uplands surveyed in Zion (Map II.17). It is surrounded by sheer cliffs and steep slopes on all sides. The area has several communities and subdivisions of each, listed below. The third author performed a survey in mid-July 1988, and supplied photographs (Figures II.31-II.34) of CM and all other Zion areas reported in this volume. These figures depict woodland, scrubland and dry forest vegetation and a section of the encircling cliffs.

Location and Size

Church Mesa is located above the southern end of Phantom Valley, about one mile south-southeast of Inclined Temple. The area is within the existing West Rim/Phantom Valley Research Natural Area. Like other surveyed places in the Zion Canyon section of the park, CM lies in east-central Washington County, southwestern Utah. Four 7 1/2-minute topographic quadrangles, spliced to make Map II.17, cover the mesa: The Guardian Angels, Springdale West, Springdale East, and Church Mesa. The mesa's high point, "7395", falls within the far southwestern corner of the Church Mesa sheet.

Church Mesa extends for about 1.8 miles north and south. It spans about eight-tenths mile across its midsection, a little south of the high point. The boundary line on Map II.17 encompasses some 298 acres.

Accessibility

A helicopter ferried the third author to the summit. No known, nontechnical climbing route exists, but Madany and West (1984) claim that deer can gain access to the top. An agile person might be able to use the same route, but the intrusion of domestic livestock or any sort of all-terrain vehicle is clearly impossible. Foot travel over the top is not arduous, but in places it is obstructed or slowed by oakbrush and sagebrush in particular (Figures II.33 and II.34).

Relict Character

Church Mesa's communities must be entirely pristine. They are defended from intrusions by the cliffs, and have never drawn the attention of commodity interests. No signs of overbrowsing by native ungulates were observed. Evidence of major natural catastrophes was likewise missing.

Geology and Terrain

The great bulk of the mesa's acreage is underlain by the regionally common Navajo Sandstone. Remnants of the overlying, upper Jurassic Carmel Formation form knobs or "mini-mesas" (Figure II.33, upper right), including the aforementioned highest point.

Most of the terrain is planar or moderately sloping (Figures II.31 and II.32). Aside from the knobs, a little steeper, timbered land also occurs (Figure II.34, skyline). The summit is almost continuously vegetated.

Vegetation

Although closed coniferous forests are present on CM, the evergreen and deciduous vegetation is basically open in character (Figures II.31-II.34). For instance, there is a fine example of ponderosa pine savanna (Figure II.32; Figure II.34, upper half). Types present appear to be:

1. **Abies concolor (ABCO) Series.** (Areally limited).

2. **Pinus ponderosa/Quercus gambelii (PIPO/QUGA).** (Figure II.32).

3. **Quercus gambelii (QUGA) Series.** (At least two distinct associations, especially with Artemisia tridentata).

4. **Arctostaphylos-Amelanchier** (Not in Table II.1, but distinct and possibly unique to Zion NP).

5. **Stipa comata (STCO) Grassland.** (With Muhlenbergia montana and Artemisia tridentata).

Management as a Relict Area

Prospects for maintaining pristine conditions atop Church Mesa are excellent. There are no foreseeable intrusions, and only helicopter landings are really feasible for access. The Park Service has full authority to limit or prohibit them. Visitation impacts are immaterial; the general public has never gotten to Church Mesa and will probably not show any interest. The area's terrain and vegetal conditions fully merit Research Natural Area status. Seclusion for scientific work would be guaranteed.

Regional Significance

Like all the other surveyed relict sites in Zion, CM could stand alone as a Research Natural Area even if it were not already within a designated one--it has well over 100 acres. Church Mesa appears to harbor as yet incompletely defined vegetation types that would be valuable additions to the regional RNA network. Ponderosa pine/Gambel oak and manzanita/serviceberry seem to be two such associations with little or representation in other RNAs, unless one considers parcels of the three natural areas in Zion.



Map II.17 Location and boundary of Church Mesa. Quadrangles mentioned in text (four total).



Figure II.31 Oak-sagebrush shrublands are predominant on the southeastern part of Church Mesa.



Figure II.32 A ponderosa pine savanna occupies a small, prominent knoll on the northern part of the mesa.



Figure II.33 The predominant aspect of Church Mesa, showing the deciduous scrubland, overtopping low ponderosa pine, the surmounting knolls and pillars, cliffside shrubbery, and north-facing, mesic forest.



Figure II.34 A closer view of the oak-big sagebrush scrub and the mature ponderosa stands. Discontinuous oakbrush grows in shrub form beneath and between the trees.

GREATHEART MESA

Introduction

Greatheart Mesa (GM) is one of the smaller albeit officially named sites inspected in Zion. It is within the existing West Rim/Phantom Valley RNA. The mesa is a definite terrain "island", with a rather simple layout (Map II.18). Its summit is continuously clothed with forest, woodland and scrubland vegetation in undisturbed condition (Figures II.35-II.38). The third author used a helicopter flight to survey GM in mid-July 1988. The pictures were taken from the helicopter.

Location and Size

Greatheart Mesa is located between the Left and Right Forks of North Creek, about two miles north-northeast of the South Guardian Angel and one mile east-northeast of Guardian Angel Pass (Map II.18). The vicinity is east-central Washington County, southwestern Utah. The mesa extends for about nine-tenths mile on its long axis. It is from two-tenths to a little less than four-tenths mile wide. Approximately 124 acres are included within the boundary line on Map II.18.

Accessibility

The mesa is surrounded by cliffs and steep slopes on all sides (Figures II.35 and II.36). Madany and West (1984) claim that deer can gain access to the mesa top, but livestock and vehicles clearly never could. The right-center of Figure II.35 shows an inclined part of the mesa's side that could be ascended by deer, small animals, or careful hikers. There are no trails or marker cairns, and the visiting public does not get up to GM's summit.

Relict Character

Greatheart Mesa is clearly a bonafide relict vegetation site. No signs of man, historic or recent, were seen within the area (Figures II.35-II.38). Evidence of natural disturbances such as hot fires or windthrow was lacking. Plant communities appear to be in climax and exemplary condition.

Geology and Terrain

Greatheart Mesa is shown on some maps as comprised of the Carmel Formation, but it appears to be entirely or almost entirely comprised of the older, underlying Navajo Sandstone (Figures II.35 and II.36). The steeper and densely vegetated parts of the summit may have Carmel parent material, however (Figure II.38, bottom).

The mesa top has very little level terrain. Gentle to moderately steep slopes with a gamut of exposures are present (Figures II.36-II.38). Elevations range from 6800 feet on the rim to 7405 feet on the "peak", for a local relief of about 600 feet. This span is most compactly expressed on the east-central part of GM (Figure II. 36; Figure II.37, skyline). Tall forests are confined to northerly aspects (Figure II.38).

Vegetation

The mix of plant communities is fairly diverse, especially considering GM's size. Slope aspect is an influential factor. Defined (Table II.1) and undefined series and associations present appear to be:

1. **Abies concolor Series (ABCO).** (Figure II.38).

2. **Pinus ponderosa Series (PIPO).**

3. **Quercus gambelii Series (QUGA).**

4. **Pinus edulis/Quercus gambelii.** (Figure II.36).

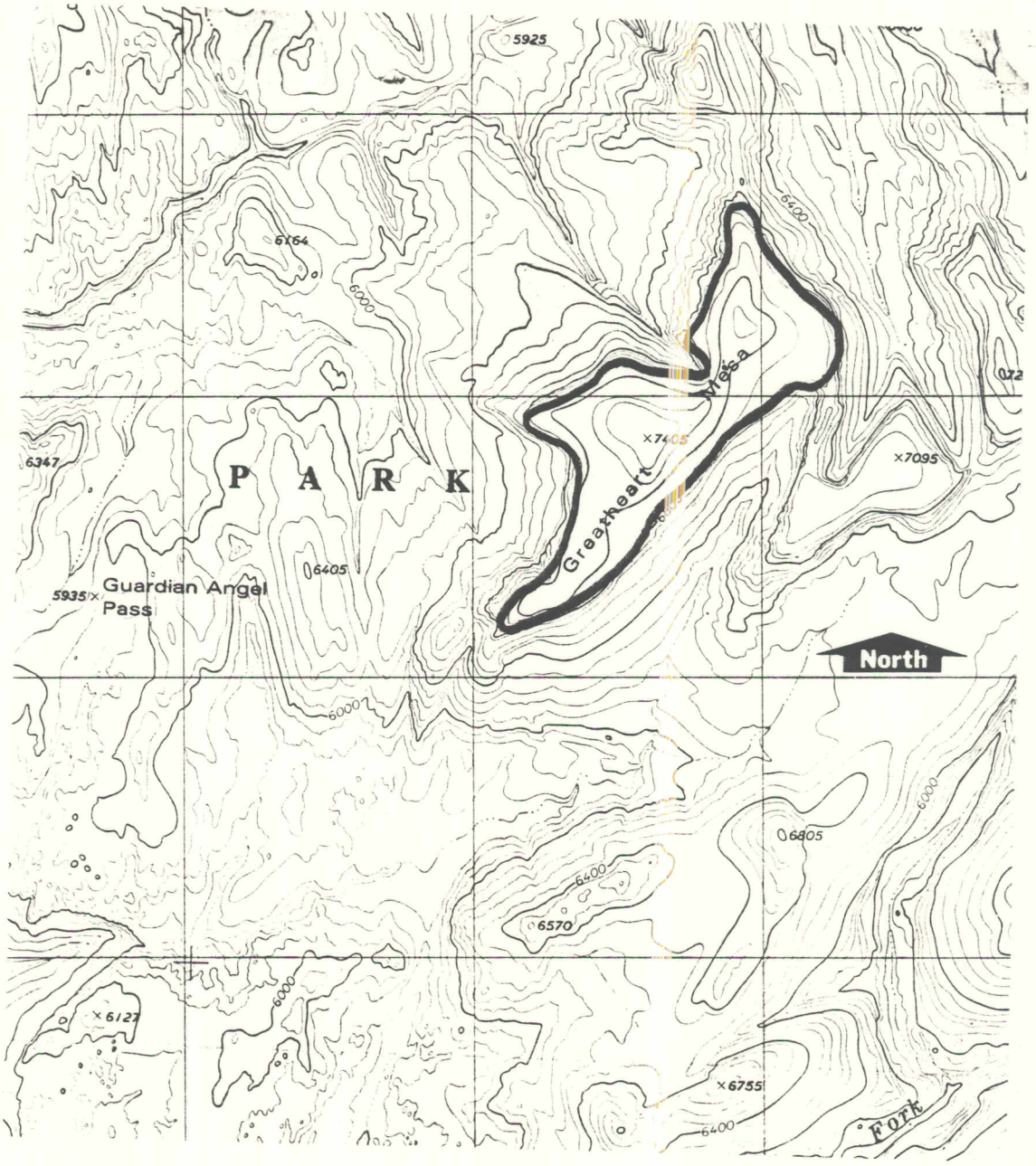
5. **Arctostaphylos-Amelanchier.** (Figure II.37).

Management as a Relict Area

Greatheart Mesa is an excellent refugium for pristine vegetation communities. It comprises a well-defined area whose difficult access would preclude virtually all potential use- or management-related conflicts. No active management measures need be taken, particularly because it is very unlikely that visitors will make their way to the mesa top.

Regional Significance

Even if it were not already in an RNA, Greatheart Mesa would exceed the Park Service's size minimum. It supports community types (some of limited extent) that may be very uncommon or absent outside of Zion National Park. However, some of the series or associations listed above were noted on other protected uplands in the park, such as Church Mesa. Greatheart Mesa does not appear to harbor any types not found in another surveyed site, or which are regionally uncommon. Nonetheless, GM could be a candidate for the regional network, if only as a recognized subdivision of the existing, larger RNA.



Map II.18 Location and boundary of Greatheart Mesa. The Guardian Angels 7.5′ quadrangle.

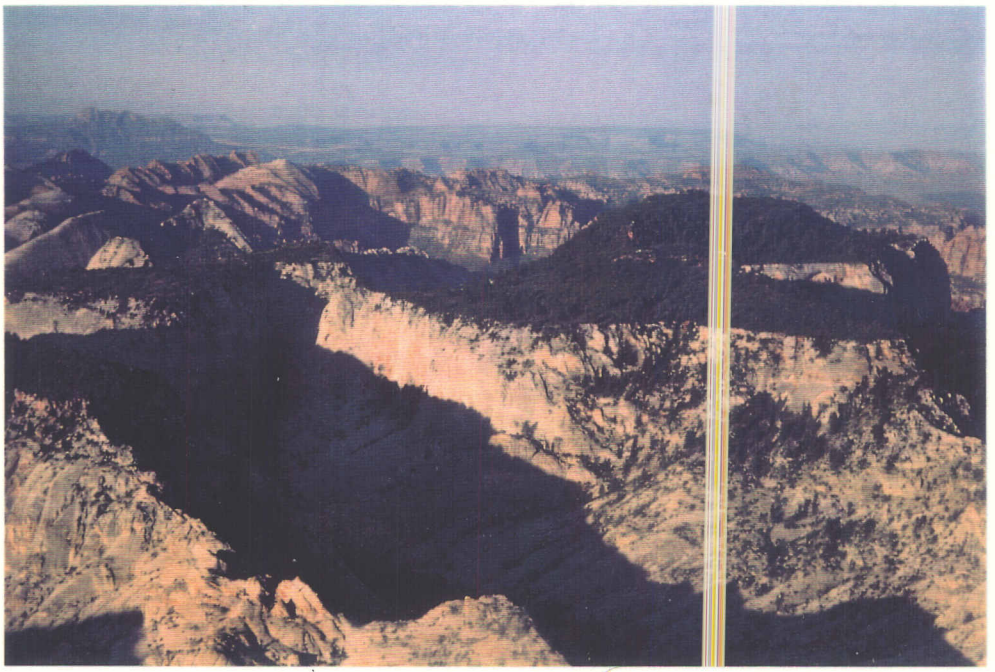


Figure II.35 Manzanita-serviceberry, pinyon-oak, and mixed conifer stands occur on Greatheart Mesa, seen here from the northeast.

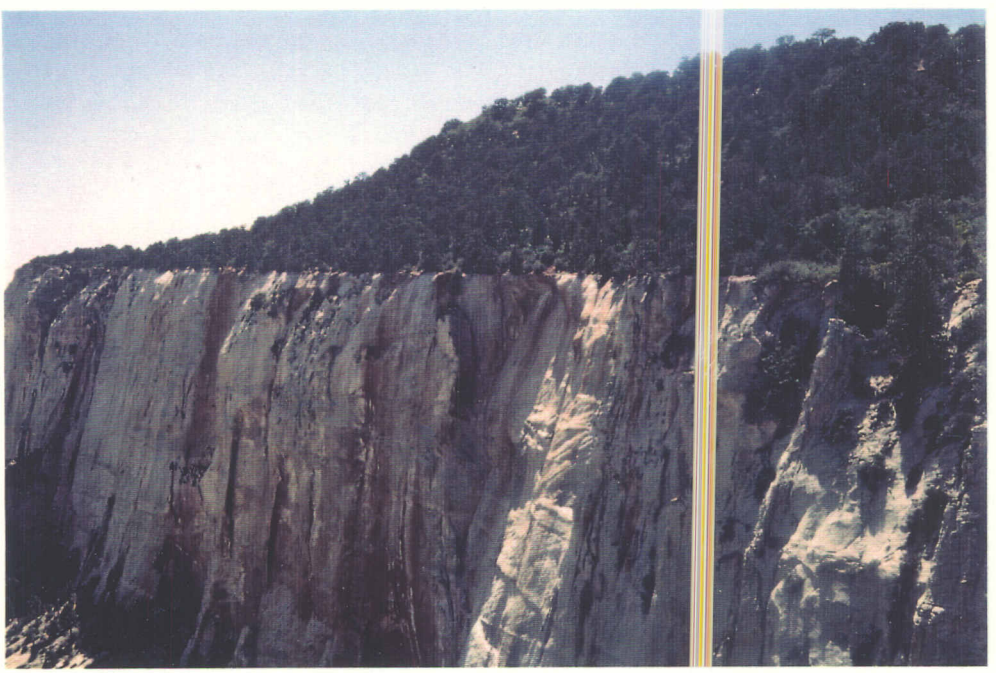


Figure II.36 A panel of pinyon-oak woodland descends steeply to the sheer, impassable cliffs rimming Greatheart Mesa on its east side.



Figure II.37 An excellent example of the manzanita-serviceberry community on a low ridgetop.



Figure II.38 Mixed-conifer forest on a north-facing slope in the center of Greatheart Mesa. Tree species present are Douglas-fir, ponderosa pine, and white fir.

HANGING CANYON

Introduction

"Hanging Canyon" (HC) was coined for a perched drainageway nestled against and below Timber Top Mountain (Map II.19; Figure II.39). In contrast to all other surveyed sites in Zion, HC contains a basin rather than a plateau situation. Its isolation from human influences originating on lower lands is nonetheless just as good as the mesa tops'.

Hanging Canyon forms a logical single relict-area site with Timber Top Mountain (pages 132-136), but foot travel between the two places is impossible (Figure II.39). Tuhy inspected both areas in mid-July 1988. Madany and West (1984) did not use HC in their study, which partly took place on Timber Top Mountain (TTM). Hanging Canyon is not part of the existing, 500-acre Kolob Mesas RNA.

Location and Size

Hanging Canyon is situated on the west side of TTM, and is the westward-draining canyon immediately north of TTM's main east-west arm (Map II.19). The vicinity is the west-central part of the park's Kolob Section, in northeastern Washington County, southwestern Utah.

Hanging Canyon is about one mile long, from its eastern to northwestern tips. It extends for about six-tenths mile north and south at its widest point. The drainageway itself is about two-thirds mile long (Figure II.39, center bottom). At about 175 acres, HC is the second-largest survey site in Zion National Park.

Accessibility

This area is inaccessible to livestock and other consumptive resource uses. Its accessibility to large native herbivores was not determined, but is probably not of the same extreme degree as Timber Top Mountain. Likewise, the possibility of reaching HC on foot (without technical climbing gear) was not evaluated. It is probably best to assume that deer, small animals, and humans can reach this area. However, a route remains to be spotted and verified and is likely to be arduous or dangerous.

Relict Character

The pristine qualities of Hanging Canyon are probably fully on par with those of genuinely relict sites elsewhere in Zion, but plant communities are probably influenced (however subtly) by native ungulates. We detected no signs whatsoever of human activity, including camping and visitation (this part of the park is well away from recreational byways and cannot be reached easily or at all from LaVerkin Creek).

Geology and Terrain

The bedrock of the entire area consists of Navajo Sandstone (Figure II.39). Much of the terrain is bare rock, or is sparsely vegetated. However, fairly dense forests have developed on colluvium (Figures II.39 and II.40). Unlike the Zion mesas reported in this volume, Hanging Canyon has extensive areas of crevices that may concentrate precipitation and catch wind- and water-borne soil.

Vegetation

Hanging Canyon supports three vegetation expressions: coniferous forest, shrublands, and diminutive herblands in the crevices. The defined and undefined types appear to be:

1. **Abies concolor/Berberis repens (ABCO/BERE), Berberis repens phase.** (Probable).

2. **Abies concolor/Quercus gambelii (ABCO/QUGA).** (Intergrade with ABCO/BERE; also probable).

3. **Quercus gambelii (QUGA).** (The oak is short-statured, and closely intermixed with Arctostaphylos).

Finally, unlike the mesas, Hanging Canyon harbors a "slickrock crevice plant" community that is apparently a Zion speciality. At the time of the survey, a Brigham Young University group was quantitatively studying this vegetation throughout the park, but generally in foot-accessible places.

Management as a Relict Area

Hanging Canyon poses no stewardship challenges if it is to remain a full-fledged relict area. Any "upstream" influences all originate on Timber Top Mountain, itself defended from intrusions. With the central part of TTM, HC forms a complete, small, upper watershed. No actions seem to be necessary to perpetuate the area's forests, scrublands and specialized plant life. A threatened, endangered and sensitive (TES) species inventory here would be desirable someday; the area probably has a greater likelihood of rare plants than do the more densely-vegetated mesas.

Regional Significance

With Timber Top Mountain, HC appears to be a desirable addition to the regional RNA network. It forms a complete upper drainage and exceeds the size minimum in Park Service directives (National Park Service no date). If cojoined, Timber Top Mountain and Hanging Canyon could become a new Research Natural Area of about 321 acres (Map II.19, exterior heavy line).



Map II.19 Location and boundary of Hanging Canyon. Kolob Arch 7.5′ quadrangle. The adjacent Timber Top Site appears in crosshatching on right.



Figure II.39 Mixed-conifer forests and manzanita-oak shrublands occur on the slopes of Hanging Canyon, on the west side of Timber Top Mountain.

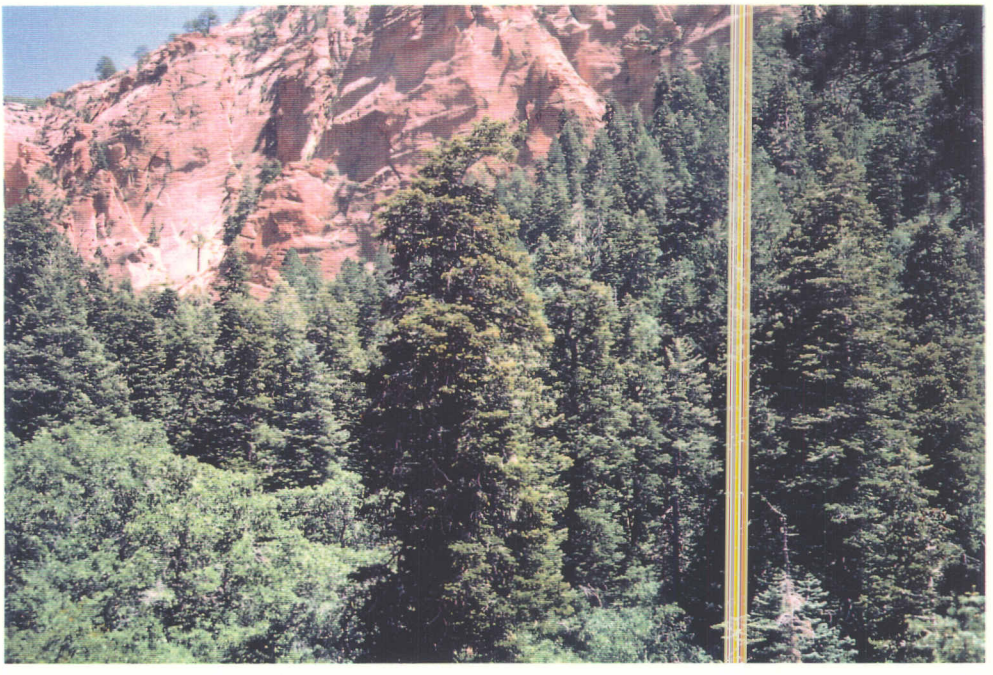


Figure II.40 A closer view of the mixed-conifer forest. Douglas-fir and white fir are the species evident here, with essentially no ponderosa pine.

TIMBER TOP MOUNTAIN

Introduction

Timber Top Mountain is the largest of the isolated mesas in the Kolob section of the park (Figure II.41). If considered of a piece with Hanging Canyon, it is still larger (page 129). Unlike HC, TTM is one of three units of the existing Kolob Mesas RNA. Tuhy inspected TTM in mid-July 1988.

The mesa top supports closed-canopy and open coniferous forests, along with dense shrublands beneath and apart from the trees (Figures II.42 and II.43). Madany and West (1984) used Timber Top Mountain in their fire-history and forest-composition study, reaching the area by helicopter. (Very minor impacts (wood specimen removal) resulted from their sampling work.)

Location and Size

Timber Top Mountain is located just north of Gregory Butte in the angle formed by LaVerkin Creek and Timber Creek (Map II.20). The general vicinity is northeastern Washington County, southwestern Utah, in Zion's Kolob section. The mountain (or mesa's) top extends for about 1.4 miles, and is from one-tenth mile (530 feet) to three-tenths mile wide. The boundary line on Map II.20 includes about 146 acres.

Accessibility

More than any surveyed site in Zion, TTM is decisively rimmed by sheer cliffs on all sides. Short of technical rock climbing, the only way to reach the site is by helicopter (Figures II.41 and II.42). Of more consequence to the vegetation and nutrient cycling, the top is also inaccessible to large native herbivores such as deer.

Relict Character

Timber Top Mountain is an unsurpassed relict area, if freedom from native as well as domestic grazing and browsing is a criterion. Signs of humanity are lacking; no recreational visitors have ever been here. Furthermore, TTM evidently has a fully natural forest-fire regime, as documented by Madany and West (1984). They had demonstrated that surface fires every 50 years or so (instead of every few years) would suffice to keep white fir and Douglas-fir at low densities in ponderosa pine forests. (However, TTM does not really have the ponderosa savanna situation evident on Church Mesa).

Geology and Terrain

Vegetation on TTM appears to be entirely underlain by the Navajo Sandstone, whose cliffs surround the top (Figures II.41 and II.42). The shrublands of the summit almost everywhere mantle the ground, making foot travel slow and indirect in places (Figure II.43). There is, though, no part of the mesa that is inaccessible to the hiker once he has landed on it.

Rugged terrain is absent, away from the rims. Some of the steeper but still moderate slopes are shown in Figure II.43, falling on either side of a ridgeline. Several slope aspects are present, but exposure does not seem to influence the location of communities very markedly.

Vegetation

Expressions present appear to be:

1. **Abies concolor/Berberis repens (ABCO/BERE), Berberis repens phase.** (Figure II.44).

2. **Abies concolor/Symphoricarpos oreophilus (ABCO/SYOR).**

3. **Quercus gambelii (QUGA) Series.** (With manzanita, serviceberry, and bitterbrush (Purshia tridentata).

4. **Cercocarpus montanus (CEMO) Series.** (Probable and minor).

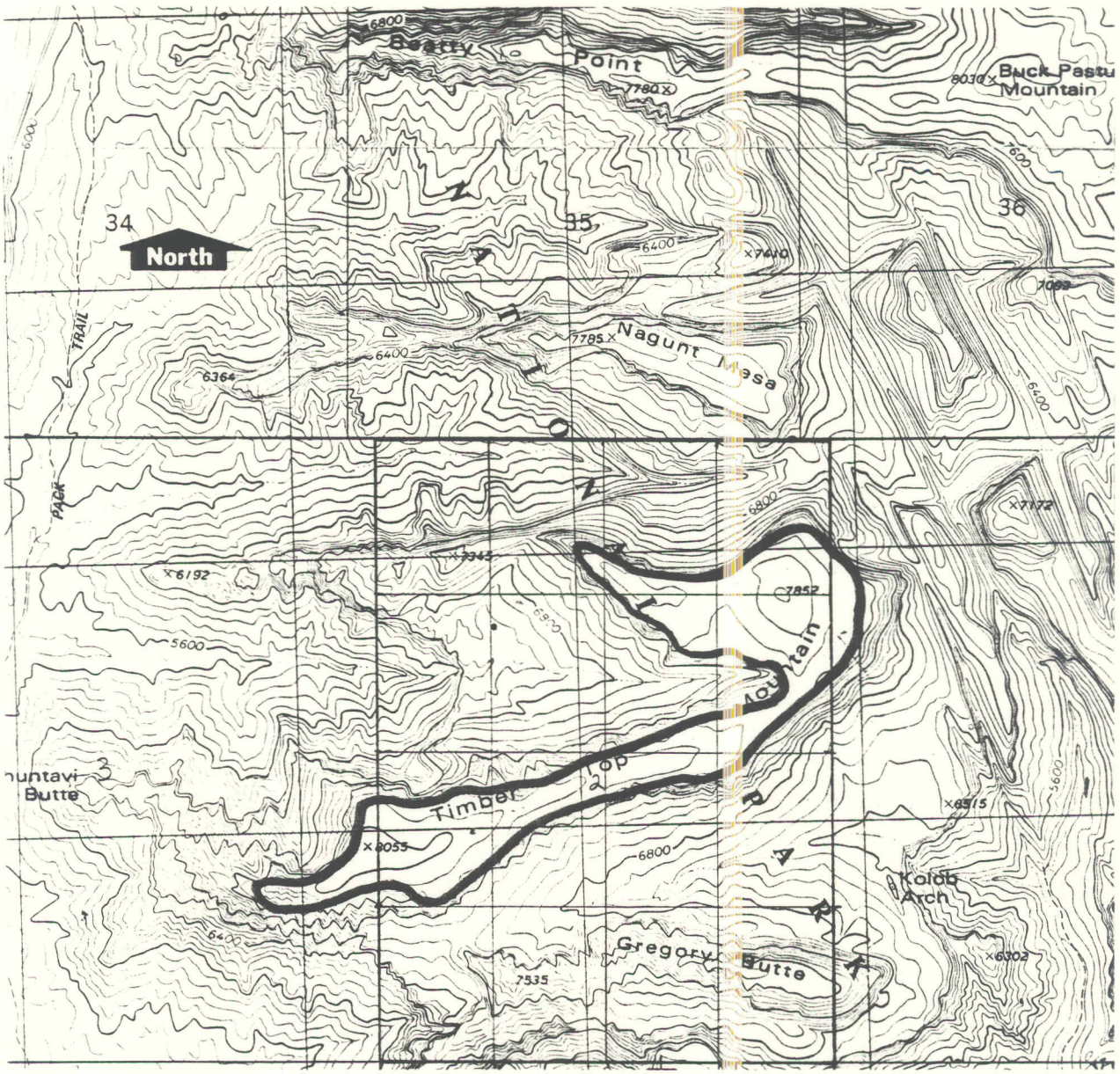
5. **Artemisia nova/Stipa comata.** (With abundant Eriogonum microthecum. Not in Table II.1).

Management as a Relict Area

It should be quite easy for Zion administrators to maintain the pristine character of TTM. Lightning-caused fires can probably be allowed to burn and exert their millennial influence on the woody vegetation. There is no danger of recreational abuses developing. Park managers may anticipate that future researchers will want to take advantage of such an isolated situation. Questions concerning sampling and occupancy impacts might therefore arise, and can be handled with current guidance (National Park Service n.d.). A concise management plan for the Kolob Mesas RNA might be a good idea, for compilation sometime in the years ahead.

Regional Significance

Timber Top Mountain does not appear to harbor any vegetation types not found on one of the other surveyed mesas. However, some redundancy is always desirable in the regional RNA network, and TTM is already an RNA. Its extraordinary isolation and research history commend a secure place in the network. In that light, the Kolob Mesas RNA deserves to be retained, better understood, and in a sense rededicated. It might be profitably expanded to include Hanging Canyon, a natural and complementary extension of Timber Top Mountain (see pages 128-131).



Map II.20 Location and boundary of Timber Top Mountain. Kolob Arch 7.5′ quadrangle.

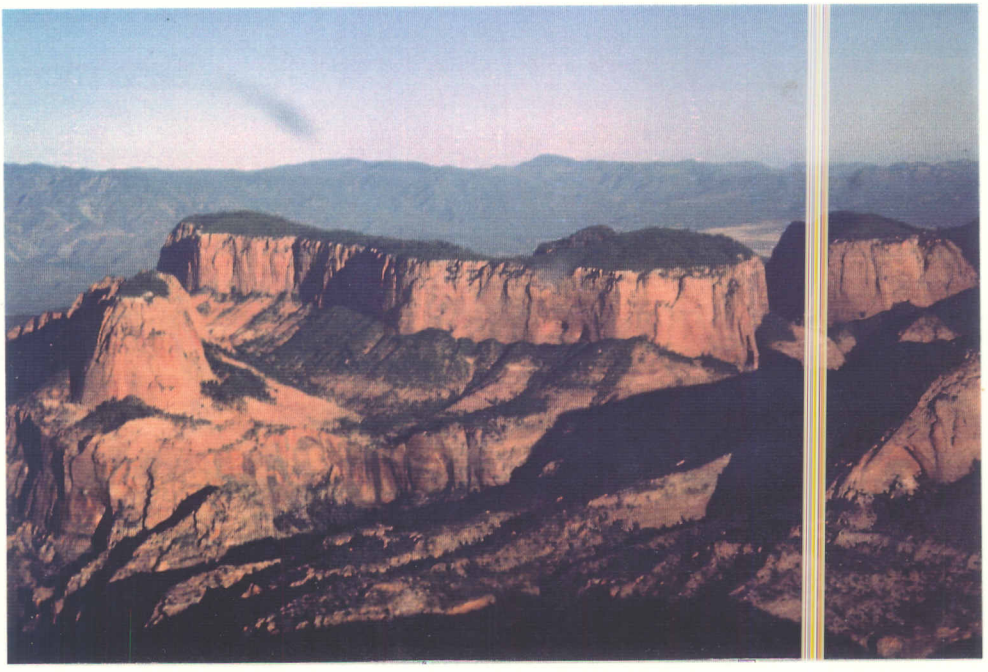


Figure II.41 Timber Top Mountain is the largest of the isolated mesas in the Kolob section of Zion NP. It is a "super-relict" site, inaccessible to large native grazing animals.

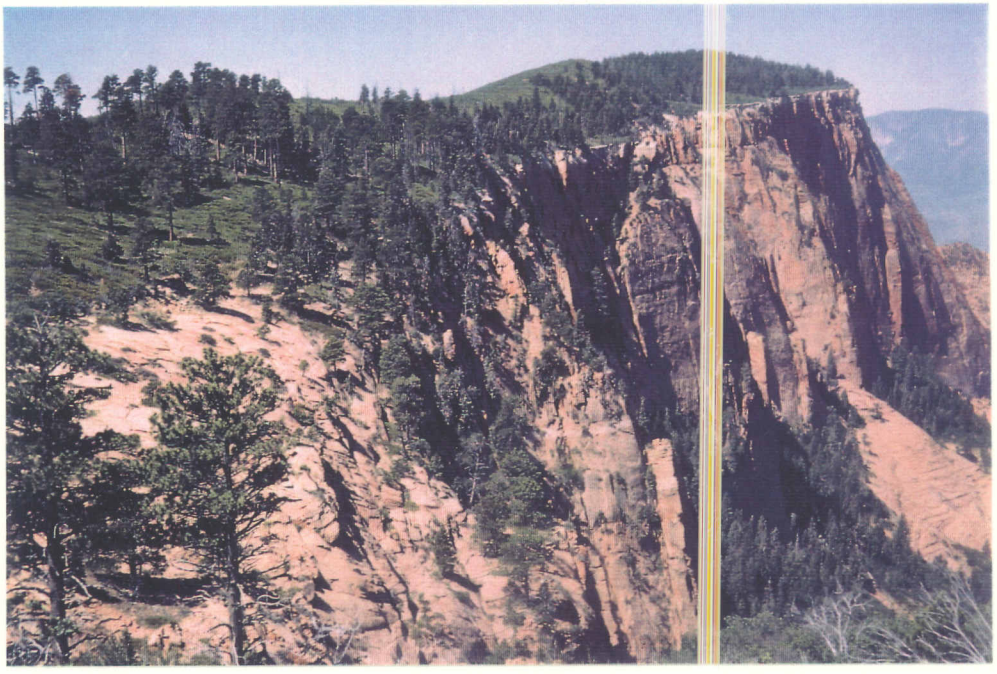


Figure II.42 The plateau of Timber Top supports mixed-conifer stands, with white fir predominant, and manzanita-oak shrublands. Vegetation descends below the mesa rim in only a few places, as shown here.

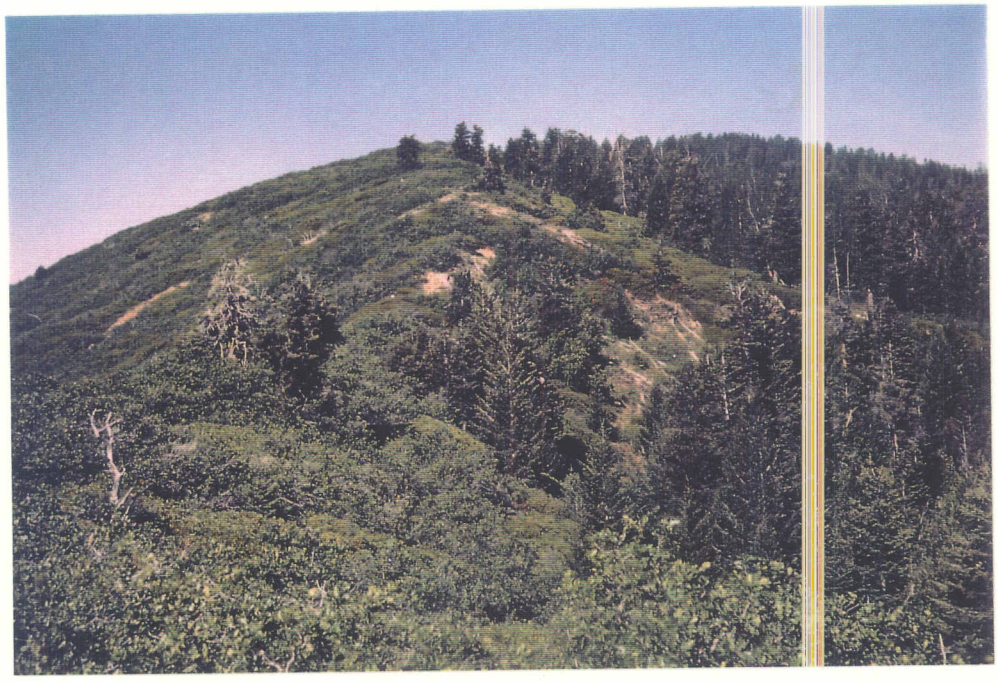


Figure II.43 A forest/shrubland ecotone on the main ridgeline of Timber Top. This locale appears in the upper right portion of Figure II.42, on the skyline.



Figure II.44 A view of the forest occupying the white fir/Oregon grape habitat type, visible in the upper right portion of Figure II.43.

WEST CHECKERBOARD MESA

Introduction

The elevationally lowest and most southeasterly site in Zion is "West Checkerboard Mesa" (WCM), in the Zion Canyon section. Although unscalable, WCM is also the closest of any to a paved park highway (Map II.21). This area is the only 1988 survey site within the existing Bighorn Research Natural Area.

The third author inspected WCM in mid-July. Coniferous forest occurs in very attenuated patches, whereas the major vegetation consists of pinyon-juniper woodlands (Figures II.45 and II.46). West Checkerboard Mesa is probably the most arid site surveyed, and the one best expressive of communities that have developed on the Carmel Formation (Figure II.46).

West Checkerboard Mesa has no research history, but Gafney and Lanner (1987) used a transect extending up Checkerboard Mesa (Map II.21) to assess the degree and context of hybridization between singleleaf pinyon pine (Pinus monophylla) and Colorado or Rocky Mountain pinyon (Pinus edulis). West Checkerboard Mesa's summit could be expected to have hybrids, but no pure singleleaf pinyon. The species did not occur on the Carmel, according to those authors.

Location and Size

The area is the next mesa immediately west of Checkerboard Mesa on the south side of the road near the east entrance of the park. The general vicinity is far west-central Kane County, southwestern Utah. The northern ramparts of the two mesas form panels of the White Cliffs (Map II.21).

West Checkerboard Mesa extends north and south for a little over nine-tenths mile, and is between one-sixth and a little over four-tenths mile wide. The boundary line on Map II.21 takes in about 131 acres. The mesa's summit stands roughly 1000 feet above the highway, but a lesser distance above the flanking drainages.

Accessibility

A helicopter was necessary for the 1988 field visit. Sheer cliffs on all sides apparently render the top inaccessible to all large animals and to hikers or scramblers. However, the existence of overland access routes remains to be confirmed or dispelled. Although the mesa is close to park developments and visitor activity, it is highly improbable that the public ever gets on top. It is not a known technical rockclimbing destination.

Relict Character

West Checkerboard Mesa is a full-fledged pristine vegetation site. No signs of humanity were seen, and it would have been impossible to place livestock on the summit. (The use history of Checkerboard Mesa is unknown, but it evidently sustained some depreciative use and was dropped from the survey itinerary.)

Geology and Terrain

The parent material consists of the Carmel Formation. Not nearly as the thick as the unconformably underlying Navajo Sandstone, the Carmel consists of red to brown siltstone layers intermixed with frequently fossiliferous limestone strata. The formation often weathers to unstable, sloping ledges, and to thin, infertile soils (Figure II.46).

Vegetation

In addition to quite small stands of mixed conifer vegetation (with Douglas-fir, white fir, and/or ponderosa pine), the area supports three xeric community expressions. The habitat type for the coniferous forest is unknown (Table II.1; Youngblood and Mauk 1985). Associations appear to be:

1. **Pinus edulis/Amelanchier utahensis (PIED/AMUT).** (However, cliffrose (Cowania) or singleleaf ash (Fraxinus anomala are alternative understory denominators (Figure II.46). The driest woodlands have essentially just the ash (Figure II.45)).

2. **Pinus edulis/Quercus gambelii (PIED/QUGA).** (Denser woodlands, with abundant Utah juniper. Oak forms a small tree (not pictured)).

Miscellaneous, uncategorized areas of sparse vegetation occur as well, apparently tied to a stratum of the Carmel.

Management as a Relict Area

West Checkerboard Mesa seems to present no stewardship challenges if maintaining its pristine character is important. Its custodianship will be subordinate to that prevailing on the Bighorn RNA (there is no separate management plan) and any eventual Wilderness. There are no forseeable threats to perpetuation of the vegetation in its present successional state. It is rather fire-proof, and under these arid, shallow-soil conditions natural changes will come about very slowly.

Regional Significance

The mesa has no community types not found elsewhere in Zion, or further afield. As a parcel of an existing RNA, analysis of its contribution to the network is best done by looking at the larger designated area. There seem to be no grounds for considering WCM as any more or less significant than the rest of the RNA, except for those parts of the natural area that may have sustained visitation or other impacts since establishment.



Map II.21 Location and boundary of West Checkerboard Mesa. The adjacent Checkerboard Mesa (non-relict) appears in crosshatching on right.



Figure II.45 An open, arid woodland of pinyon, juniper, and serviceberry. Very few other woody or herbaceous plant species are present; singleleaf ash is one of them.

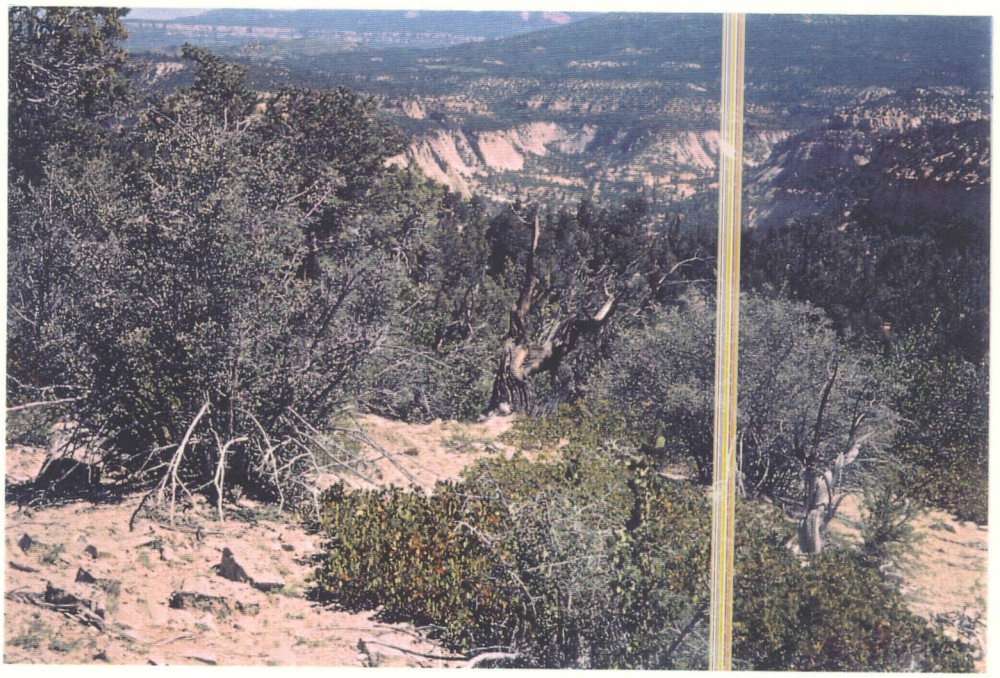


Figure II.46 Open woodlands of pinyon and juniper, with manzanita, cliffrose, serviceberry, singleaf ash and a small amount of oak, occur on the Carmel Formation on top of West Checkerboard Mesa.

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CONCLUSIONS AND RECOMMENDATIONS

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CONCLUSIONS AND RECOMMENDATIONS

The surveys reported are of all known, accessible and sizeable relict areas in Park System units of south-central and southwestern Utah. We also described a few places in Bryce, Capitol Reef and Cedar Breaks that no longer harbor undisturbed vegetation--but which are still noteworthy. All of the Zion sites are assuredly relict, and most are already in one of three Research Natural Areas.

The surveys did not reach a great amount of unnamed slickrock and slope terrain that comprises small or ill-defined, elongate land units. Doubtlessly, pristine vegetation occurs in the recesses of the Waterpocket Fold, in the depths of the Cedar Breaks amphitheater, and on a good many knobs and canyonsides in Zion. Tabulating and mapping such places would refine an accounting of the proportion of each unit that has genuinely escaped the degradative impacts of modern man.

The writeups have not left all the sites at the same point. Aside from the non-relict "special cases" like Alpine Pond Spruce, they are assignable to one of several categories, with examples: (1) pristine, but not warranting research natural area candidacy (Bristlecone Point); (2) sizeable, pristine and worthy of consideration as an RNA (Upper Deep Creek); and (3) pristine, but technically too small to deserve RNA status (7176 Mesa).

Qualifying areas are further divisible into those that appear to supply a relict-vegetation example not found in an existing RNA, and those that do not. In nearly all instances, further fieldwork and/or the collation of secondary information are necessary before a change in the current zoning or subzoning is justifiable. The research natural area establishment process and its required Natural Area Information Form (National Park Service (NPS) n.d.) are the vehicle for land-status changes within the overarching zone.

The site narratives and supporting material help meet project objectives (4) and (5) (Page 3). We also attempted to supply unit managers "with sound information on areas to close...or buffer..." (Objective 7). Fortunately, closures seem advisable in just a couple of instances, and we noted no impending conflicts with administrative, patrol, special-use, or development activities. Nondisclosure to the recreating public seems to be the best and simplest protective strategy for the majority of sites.

Relict Vegetation Examples Represented in the Four Units

The project's "analysis" objective ((2)) necessitates a comparison of the vegetation types or associations found in our survey sites with those already protected in a dedicated research natural area (Table II.20). The sites in Bryce, Capitol Reef, Cedar Breaks and Zion must also be compared with ones surveyed in other units of the northern Plateau, including Glen Canyon NRA.

Table II.20 is a reckoning of particular associations or series (Table II.1) found within our survey sites, leaving aside the very small and disturbed places. About half of the associations do not have a protected example (Table II.21, third column). Not included are apparently new types, which we coined in the vegetation description sections. These await confirmation before being placed in a revised classification scheme. We caution that the quality of an example is very important. Some of the existing RNAs lack good examples. Conversely, some areas in Capitol Reef do not equal more extensive, better-condition or diverse ones described from Glen Canyon (Tuhy and MacMahon 1988).

Table II.20 Relict vegetation examples (series and/or associations) represented within sites surveyed in Bryce Canyon NP, Capitol Reef NP, Cedar Breaks NM, and Zion NP. Refer to Table II.1 for association codes. "Existing RNA" refers to federal research natural areas of the Utah and western Colorado portions of the Colorado Plateau. Those RNA's may harbor an example of the series or a specific association, but solid information is sometimes lacking.

Series or Association	Site or Sites Where Present	Representation Within An Existing RNA
ABCO	Greatheart Mesa	Yes
ABCO/ARPA	Shooting Star Ridge Tri-Story Canyon	Yes
ABCO/BERE	Shooting Star Ridge 6665 Mesa Hanging Canyon Timber Top Mountain	Yes
ABCO/QUGA	Hanging Canyon	No
ABCO/SYOR	Timber Top Mountain	Yes
ABLA/BERE	Bartizan Point	No
ABLA/RIMO/RIMO	Bartizan Point	No
ABLA/RIMO/THFE	Alpine Pond Spruce Bartizan Point	No
PIEN/EQAR	Bartizan Point	No
PIFL/PILO	Bristlecone Point Upper Deep Creek Bartizan Point Tri-Story Canyon	Yes
PIPO	Greatheart Mesa	Yes
PIPO/ARPA	Bristlecone Point Mud/Noon Canyon Upper Deep Creek	Yes
PIPO/PUTR	North Fairyland Bench	No
PIPO/QUGA	Church Mesa	Yes
PIPU/COSE	Upper Deep Creek	No
PIPU/JUCO	Shooting Star Ridge Tri-Story Canyon	Yes

(continued)

(Table II.20, continued)

PSME/ARPA	Shooting Star Ridge	Yes
PSME/CELE	Boat Mesa Mud/Noon Canyon	No
PIED	7176 Mesa Fremont River Gorge Boat Mesa	Yes
PIED/AMAL (AMUT)	6665 Mesa West Checkerboard Mesa	Yes
PIED/CEMO	Mud/Noon Canyon	No
PIED/QUGA	Greatheart Mesa West Checkerboard Mesa	Yes
JUOS/PIED/CELEIN	Blowout Flat	No
ACNE	Halls Creek Narrows	No
CEMO	6665 Mesa Timber Top Mountain	Yes
QUGA	Boat Mesa 6665 Mesa Church Mesa Hanging Canyon Timber Top Mountain	Yes
ATCORR Shale Barren	Mud/Noon Canyon	Yes
ORHY/PSLA	Halls Creek Narrows	No
STCO	Blowout Flat Church Mesa	No
SAEX/BAR	Halls Creek Narrows	No
(Hanging Gardens)	Halls Creek Narrows	Yes

Relict Vegetation Examples Not Represented in the Four Units

Many series and associations are not found within a relict area of these four NPS units (Table II.21). This list is at least as long as the one showing those that are represented (Table II.20). Missing are a good many montane forest, riparian and riverine types, and wet or organic-soil situations generally (Table II.21). More subtly, higher-elevation pinyon-juniper woodland expressions are lacking, such as those with grassy understories and deeper soils. Several arid and semiarid shrubland types are absent. Cowania mexicana, Atriplex gardneri, and the areally limited Artemisia cana are examples.

Table II.21 shows that some of the unrepresented types evidently occur within an existing RNA (second column). Whether they do or not (and the RNA may not be on Park System lands), they sometimes exist on another unit we surveyed or which Tuhy and MacMahon (1988) characterized. A row-wise computation shows that some 42 types are not found in any site reported in this volume, in an existing RNA on any ownership, or in another unit of the survey project. Some of the types, if they could be found in relict or near-relict condition, have desert-lowland, riparian, or montane-forest environments. These often sustained historically severe grazing, water-diversion and logging impacts in southern Utah and western Colorado.

Lack of representation is attributable to several factors. Even Capitol Reef covers a small fraction of the northern Colorado Plateau. Bryce and Cedar Breaks are but a tiny fraction each. In contrast to Canyonlands and Glen Canyon, the four units do not have much genuinely low-elevation terrain that might encompass blackbrush or variable-shrubland communities. Cedar Breaks and Bryce have some montane lands, but they comprise a very small part of the vast, richly forested High Plateaus of Utah.

Capitol Reef NP has famously varied semidesert and woodland landscapes, plus some fine riparian situations. Its relict and near-relict sites harbor an array of woodland variants, including some not well reckoned by the classification. However, by no means are all "desert" (shrubland and grassland) types present in Capitol Reef, diverse as its habitats are. Table II.21 confirms that some such missing types occur in Glen Canyon and Canyonlands, as do important wooded riparian variants.

Acre for acre, Glen Canyon National Recreation Area certainly has a more expansive and more diversified relict-site "resource" than does adjacent Capitol Reef. To begin with, Glen Canyon is larger--it has a much greater proportion of topographically-defended upland topography, plus long canyons. As interesting as places like Blowout Flat and 7176 Mesa are, they are not nearly as big or varied in vegetation as are Glen Canyon's Horn Mesa (1115 acres) or 5381 Mesa (1820 acres). And, unfortunately, as floristically and vegetally rich a canyon as the Fremont River Gorge no longer has any certifiably relict streamside communities.

One consequence of this size disparity between Capitol Reef and Glen Canyon is that shrubland associations like Coleogyne ramosissima/Stipa hymenoides are very well-expressed in GLCA but poorly in CARE. The national recreation area also harbors much better-developed hanging gardens, sidecanyon riparian groves, and several grasslands superior to Blowout Flat.

Table II.21 Relict vegetation examples (series and/or associations) not represented within sites surveyed in Bryce Canyon NP, Capitol Reef NP, Cedar Breaks NM, and Zion NP. Refer to Table II.1 for association ("type") codes. The third column shows whether the example was encountered within a relict area of another unit (e.g., Canyonlands NP) during surveys there.

Series or Association	Represented Within An Existing RNA Elsewhere	Potentially Represented on Another Unit
ABCO/ACGL	No	No
ABCO/ARUV	No	No
ABCO/EREX	No	No
ABCO/FEAR	No	No
ABCO/JUCO	No	No
ABLA/ACCO	No	No
ABLA/ACGL	No	No
ABLA/CAGE	No	No
ABLA/CARO	No	No
ABLA/JUCO	No	No
ABLA/VAMY	No	No
PIEN/RIMO	No	No
PIPU/BERE	No	No
PIPU/POFR	No	No
PIPO/ARAR	No	No
PIPO/ARUV	No	No
PIPO/BOGR	No	No
PIPO/CELE	No	Dinosaur
PIPO/FEAR	No	No
PIPO/MUMO	No	No
PIPO/QUUN	No	No
PIPO/SYOR	?	No
PSME/BERE	Yes	No
PSME/CEMO	No	No
PSME/FEAR	No	No
PSME/QUGA	No	No
PSME/SYOR	Yes	No
PSME/HODU	No	Curecanti
ALIN	No	Curecanti
BEOC	No	Glen Canyon
POAN	No	No
POTR	Yes	No
JUOS/AMUT	No	No
JUOS/ARTR	No	No

(continued)

(Table II.21, continued)

PIED/ARTR	No	No
PIED/BOGR	No	No
PIED/CORA	No	Canyonlands
PIED/POFE	No	Canyonlands
PIED/PUTR	No	No
QUGA/AMAL	No	No
ARCA	No	No
ARTR	No	No
ATCA	No	No
ATCO	Yes	Canyonlands
ATGA	No	No
CORA	Yes	Canyonlands
COME	No	No
EPVI	No	No
POFR	No	No
(All Salix Series Except SAEX)	No	No
SAVE	No	No
HIJA	Yes	Canyonlands
Arenaria-Paronychia-Silene	Yes	No
CALE	No	CBNM?
(All Carex Series)	No	No
ELPA	No	No

Suggestions for Management of Surveyed Sites

Wherever found, of whatever size, and whether "representative" or not, relict sites are a precious and limited resource. They have inherent worth, and many applied uses (formally recognized in research natural area directives). Unless a particularly compelling need for the lands of a relict site arises, all the ones we surveyed should be managed under a total nonoccupancy, nondegradation concept. We include those sites we do not feel are qualified for RNA candidacy, and those that are non-relict. Some of the Zion sites are already protected within RNAs. However, explicit plans may be lacking for the RNA as a whole, much less the topographic subdivisions we surveyed.

As we noted toward the end of several writeups, we saw no instances in which interventionist techniques (such as prescribed burning or grazing) are needed to perpetuate the community of interest in the face of plant succession. These places are best left alone and simply monitored.

Pending more detailed surveys, we intended that the suggestions for mangement found in each writeup be inclusive. Similarly, we felt that the existing management regime and subzoning were quite satisfactory for practically all sites. The existence of relict vegetation simply supplements the recognition and protection the sites already receive. Bristlecone Point in the Bryce amphitheater is a good example. We do not think that any relict or near-relict site is within an inappropriate zone, such as "Development". The Conservancy takes no position on eventual Wilderness classification by Congress of lands within the Wilderness Subzone.

We see three generic issues that apply to more than one area. First, although we discerned no major conflicts between public uses or preferences and the sites' integrity, the necessity of selective, permanent, year-round closures should be considered. Blowout Flat is probably our best example. A closure action should accompany a decision about RNA candidacy in this and any other instance. In the case of Research Natural Areas, the Park Service's guidelines state, "It may be appropriate to exclude all uses except nonmanipulative research" (NPS n.d.: 16).

Second, we encourage managers to consider the interpretive opportunities some of the sites afford. If the involved area is an RNA, activities "will be provided off-site, except in cases where well-supervised on-site interpretation of ongoing research is possible" (NPS n.d.: 16). Boat Mesa, Bristlecone Point, and Timber Top Mountain are among the most visible and "interpretable" of the sites that do not merit nondisclosure.

Third and finally, we encourage the installation of long-term studies on a few "flagship" sites that qualify as RNA candidates. We elsewhere pointed out that our photographic stations and the 1990 color panoramas could complement more specialized, data-based ecologic monitoring and research (Schelz and Van Pelt 1990; Turner 1990).

Potential Additional Surveys

The Capitol Reef and Zion surveys did not reach some sites that appear on maps to be topographically defended from intrusions. Followup work would require a helicopter or rockclimbing. However, manpower should probably be first directed to describing more thoroughly the features of seen areas and to resolving their RNA suitability (Table II.22).

Unsurveyed sites would often be dry, steep, and/or rocky, with no known special features or needed vegetation elements. The Nature Conservancy will not commence surveys of such new areas in the forseeable future, preferring to devote resources to more intensive characterization of places already seen and reported in this volume. One idea for the future would be installation and use of permanent photographic stations atop the mesas in Glen Canyon and Zion. This possibility has been discussed with the Cooperative Park Studies Unit in Flagstaff, but was not funded in Fiscal Year 1992. The methods used in Bryce, Capitol Reef, Canyonlands and elsewhere would be duplicated (Schelz and Van Pelt 1990).

Designation of Selected Sites as Research Natural Areas

A research natural area proposal must include several components derived from site inspections. Three important ones, not tackled in our surveys, are a narrative boundary description, including bearings and distances; a description of cultural resources; and an inventory of any "endangered, threatened, rare or unique" species (NPS n.d.: 15). The Nature Conservancy can assist with these and other field-based requirements (with the exception of cultural resources), possibly under cost-share project arrangements.

Twelve of the 21 surveyed areas appear to qualify for further consideration as RNAs (Table II.22). We did not automatically equate relict character with the need for more study or for candidacy, and some of our suggested sites (Table II.22, bottom) are below the nominal size minimum of 100 acres (40 hectares) (NPS n.d). Exceptions would need to be considered case-by-case. Accessibility for research is another criterion, however not hard and fast where mesa-top topography is the rule and helicopters or ropes are necessary to get investigators and scientific gear onto the site.

We believe that very few if any of the sites nearly qualify for any other kind of special park designation, such as Wild and Scenic River or Experimental Research Area. However, the Fremont Gorge should be considered for some kind of botanical special interest classification.

The survey narratives and the analyses in the tables of this section point to zero RNA prospects in Bryce Canyon, three in Capitol Reef, three in Cedar Breaks, and six in Zion (Table II.22). Such an analysis will need to incorporate supplemental values, size, and manageability. Our computation includes existing RNAs whose qualifications probably deserve a reassessment.

Policies and procedures are in place and well-tested for initiating research natural area designations (NPS n.d.). In harmony with this project, the guidelines stipulate that activity on a given park or monument is to be part of a larger endeavor, involving other NPS units and lands administered by multiple-use federal agencies (FCER 1977). Efforts within "the same biogeographical region" should be complementary (NPS n.d.: 14). The Colorado Plateau Ecoregion is such a region. The superintendent of the unit where the potential RNA is located has primary responsibility. The Nature Conservancy and other cooperators can assist with both fieldwork and documentation phases. Those culminate in a Natural Area Information Form for approval by the Regional Director and the Washington Office.

These inspections of parklands typifying "base conditions" have been timely and comparatively inexpensive (roughly $1,000 total per site). They directly respond to the Park Service's mission of retaining a sample of pristine natural environments for inspiration, upper-level education, and both unit-based and academic research. Some of our relict sites can become RNAs, but all can be better understood and more knowledgeably managed with the information and photographs The Nature Conservancy has acquired.

We identified a handful of sites whose features would be protected most economically via continued anonymity, plus nondisclosure to the nonscientist public. Conversely, there is an obligation to publicize RNAs, and to make them available to the scientific and interpretive communities. Given Park Service and societal initiatives in climatic-change assessment, the relict areas afford especially secure "laboratories". They are places where monitoring equipment, sampling protocols, and more photographic stations could be set up--with assurance that these tools and the features they record will remain undisturbed for years to come.

Table II.22 Surveyed areas in Bryce Canyon NP, Capitol Reef NP, Cedar Breaks NM, and Zion NP that are suggested for further surveys or administrative study/confirmation for RNA status. Areas listed in order of decreasing estimated size, and segregated by rule of thumb for minimum size (NPS n.d.).

Area Name	Size in Acres	Suggested Survey or Administrative Action
	--- Above Size Minimum ---	
Shooting Star Ridge	623	Reconfirm RNA Status
Church Mesa	298	Intensive Survey
Tri-Story Canyon	226	Confirm RNA Status
Hanging Canyon	175	Intensive Survey and Add to Kolob Mesas RNA
Bartizan Point	161	Intensive Survey and Add to Amphitheater RNA
Timber Top Mountain	146	Reconfirm RNA Status
Upper Deep Creek	146	Intensive Survey and Dendrochronology Profile
6665 Mesa	143	Intensive Survey
West Checkerboard Mesa	131	Reconfirm RNA Status
Greatheart Mesa	124	Reconfirm RNA Status
	--- Below Size Minimum ---	
Blowout Flat	54	Intensive Survey and RNA Candidacy
7176 Mesa	48	Intensive Survey and RNA Candidacy

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Footnotes:

1. Includes references not cited in the text but useful for providing context, or for preparing Natural Area Information Forms later.

2. All unit-based planning documents (for example, the Statement for Management) have the unit given as the author. This practice is for the sake of convenient identifiability, even though the Department of the Interior or the NPS Rocky Mountain Region is technically the author.