ITʉS, AʉV, TE'EK

(PAST, PRESENT, FUTURE)

MANAGING SOUTHERN PAIUTE RESOURCES IN THE
COLORADO RIVER CORRIDOR

Cover photo: The *Ompi* (Hematite) Cave, a source of sacred red pigment, is one of many Southern Paiute cultural resources in the *Colorado River Corridor*.

ITʉS, AʉV, TE'EK (PAST, PRESENT, FUTURE)

MANAGING SOUTHERN PAIUTE RESOURCES IN THE *COLORADO RIVER CORRIDOR*

Prepared for:

David Wegner
Glen Canyon Environmental Studies
Bureau of Reclamation
Flagstaff, Arizona

Prepared by:

Richard W. Stoffle
Diane E. Austin
Brian K. Fulfrost
Arthur M. Phillips, III
Tricia F. Drye

with the assistance of

Angelita S. Bulletts
Carolyn Groessl
David L. Shaul

Southern Paiute Consortium
Pipe Spring, Arizona
and
Bureau of Applied Research in Anthropology
University of Arizona
Tucson, Arizona

September 1995

Report of work carried out under the Southern Paiute Consortium Cooperative Agreement with the Bureau of Reclamation, #4-FC-40-15260

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

A NOTE ON TRANSCRIPTIONAL PRACTICE

The transcriptions used in this report follow the system for writing Southern Paiute used by Bunte and Franklin (1987:297-298), despite some criticism of this orthography by other Numicists (Givon 1992; Miller 1992) because it is allophonic and not phonemic. Briefly, the vowels are as in Spanish, except that barred-u (*ʉ*) is a high central vowel, and the vowel (*ø*) is a mid, front, rounded vowel. Long vowels are indicated with two vowels. Most consonants correspond roughly to their American English equivalents. Consonant *x* is a velar fricative. Consonant *xw* is a labialized velar fricative.

It should be noted that spellings of Paiute words in quotations have been retained without any correction, except for glottal stop, which is indicated by a question mark (?), instead of the IPA symbol, for typographical convenience.

ACKNOWLEDGEMENTS

The work on which this report is based was carried out for the Glen Canyon Environmental Studies (GCES) under the Southern Paiute Consortium Cooperative Agreement with the Bureau of Reclamation, #4-FC-40-15260. This report is the result of the efforts of many individuals. The authors would like to express their sincere appreciation to David Wegner and his staff at the Bureau of Reclamation for their continual support throughout this study. This study could not have been done without their assistance in providing transportation to and through the study area. Special thanks is due to Mark Gonzales and Chris Brod of the GCES Survey Department for their advice, assistance, and excellent work. Thanks to Terence Arundel, also of GCES, for his assitance. We also appreciate James Duval and Stewart Houston for volunteering their time and skills to assist with the field surveys. Thanks also to Larry Stevens for providing information about animals within the *Colorado River Corridor.*

This report was prepared at the Bureau of Applied Research in Anthropology (BARA) at the University of Arizona. Sincere thanks to the BARA staff, especially Maria Rodriguez and Carolyn Staggs, for all of their assistance and rapid response to our many questions and requests. Thanks are also due to Tracey Hummel, University of Arizona Printing and Publishing Support Services, for overseeing the production of this report.

Several organizations and individuals contributed to the study team's successful completion of the fieldwork. We thank Sonya Norman and her staff at the Arizona Sonora Desert Museum in Tucson for providing high quality photographs of animals for the ethnofaunal study. We would also like to thank the staff of OARS, Flagstaff, Arizona, for providing knowledgeable, experienced, and friendly river guides and cooks for our river trips. We appreciate their ability to provide excellent service and meals on all our trips.

Most importantly, the authors wish to express their sincere appreciation and gratitude to all of the Southern Paiute people who have made it possible for this work to occur. A special thank you is due to Gloria Bulletts Benson, Kaibab Paiute Tribal Chairperson, and Geneal Anderson, former Chairperson of the Paiute Indian Tribe of Utah (PITU), for identifying this project as something highly important to the Southern Paiute Nation and contributing support throughout it. Thanks also to Alex C. Shepherd, PITU Chairman, for the openness and willingness to formally represent the Shivwits Band in this project. Thanks also to Carmen Bradley, Yolanda Hill, Amelia Segundo, and Timothy E. Stanfield, Kaibab Paiute Tribal Council Members, for taking time away from their busy schedules to learn more about this project by participating in the April 1995 trip. We thank Eileen Drye, Kaibab Paiute Community Health Representative, for her help on the ethnofaunal study trip, and Debbie Drye, Southern Paiute Consortium photographer, for her efforts to document the ethnofaunal study through photographs. We also thank Laura Perez, tribal council member, for accompanying the youth on the environmental education river trip.

To all of the involved tribal representatives who participated in the study and monitoring trips, we offer you our most sincere thanks for taking time away from your families and busy schedules to share your knowledge of traditional life and cultural resources in the Grand Canyon and Colorado River study area. Without your collaboration and participation, this study could not have been conducted. An equal share of the credit for the data and findings contained in this report are due to:

<u>Kaibab Paiute Tribe</u>

Franklin Drye
Lucille Jake
Vivienne Jake
Warren Mayo, Sr.
Gevene Savala

<u>Paiute Indian Tribe of Utah</u>

Wallea Baker
Marilyn Jake
Yetta Jake
Glenn Rogers
Eunice Surveyor

The following youth are to be commended for their participation in the Southern Paiute Youth Environmental Education Program. Their interest and enthusiasm for learning about and protecting cultural resources is critical to their tribes' future participation in the Adaptive Management Program for the Glen Canyon Dam.

<u>Kaibab Paiute Tribe</u>

Matthew Batala
Kevin Bulletts
Nicole Bulletts
Ryan Bulletts
Gabe Rogers

<u>Paiute Indian Tribe of Utah</u>

Marisa Leon
Brannon Razo
Mark Rogers

DEDICATION

This report is dedicated to the memory of Crissy Bulletts (Grandma B.). Grandma B. took two raft trips down the Colorado River and participated in the ethnobotanical and ethnofaunal studies. She also provided advice and information to Southern Paiute youth and other tribal members throughout the four years of this project. We will always remember and admire her dedication to sharing information about and protecting Southern Paiute cultural resources.

CHAPTER ONE

INTRODUCTION

The current report is entitled *Itus, Auv, Te'ek (Past, Present, Future)* because it provides a transition between discussion of past and current uses of cultural resources in the *Colorado River Corridor* and Southern Paiute efforts to develop a plan for monitoring these resources as part of the Glen Canyon Dam Adaptive Management Program.

This report concludes the first four years (1992-1995) of Southern Paiute involvement in the Glen Canyon Environmental Studies (GCES), a program initiated by the Bureau of Reclamation (BOR) in 1982. Southern Paiutes have conducted ethnographic research and participated in the Congressionally mandated Environmental Impact Study (EIS) of Glen Canyon Dam water release policies on natural and human-made resources found in the *Colorado River Corridor*. These ethnographic studies have taken place in what is called the *Colorado River Corridor* which extends 255 miles down stream from Glen Canyon Dam to the end of the free flowing river at Separation Canyon within the Grand Canyon National Park. They have concentrated on investigating the impacts of the Dam's water releases to Southern Paiute cultural resources. Since the Final EIS was published in March 1995, emphasis has been placed on what is called the Adaptive Management Program of the GCES and attention has shifted to monitoring the water release impacts.

Since 1992, Southern Paiute people representing three federally recognized tribes have participated in these ethnographic studies. These people participated because of their concerns for cultural resources contained within their holy land called *Puxant Tuvip* (Figure 1.1) and more specifically within a portion of their holy land which is the Grand Canyon regional cultural landscape called *Piapaxa 'uipi* (Figure 1.2). Cultural resources are those resources to which a community, such as an American Indian tribe, may ascribe cultural value. Examples of cultural resources are natural landscapes, viewsheds, plant communities, and archaeology sites. Cultural resources are defined by the community and identified by individuals knowledgable about its culture and traditions. They are governed by Federal and state laws (see Stoffle et al. 1995). Southern Paiute people are one American Indian ethnic group among many who have traditional lands along the Colorado River. Other American Indian groups are the Hualapai, Havasupai, Hopi, Navajo, and Zuni. The BOR, in compliance with various Federal laws and regulations,

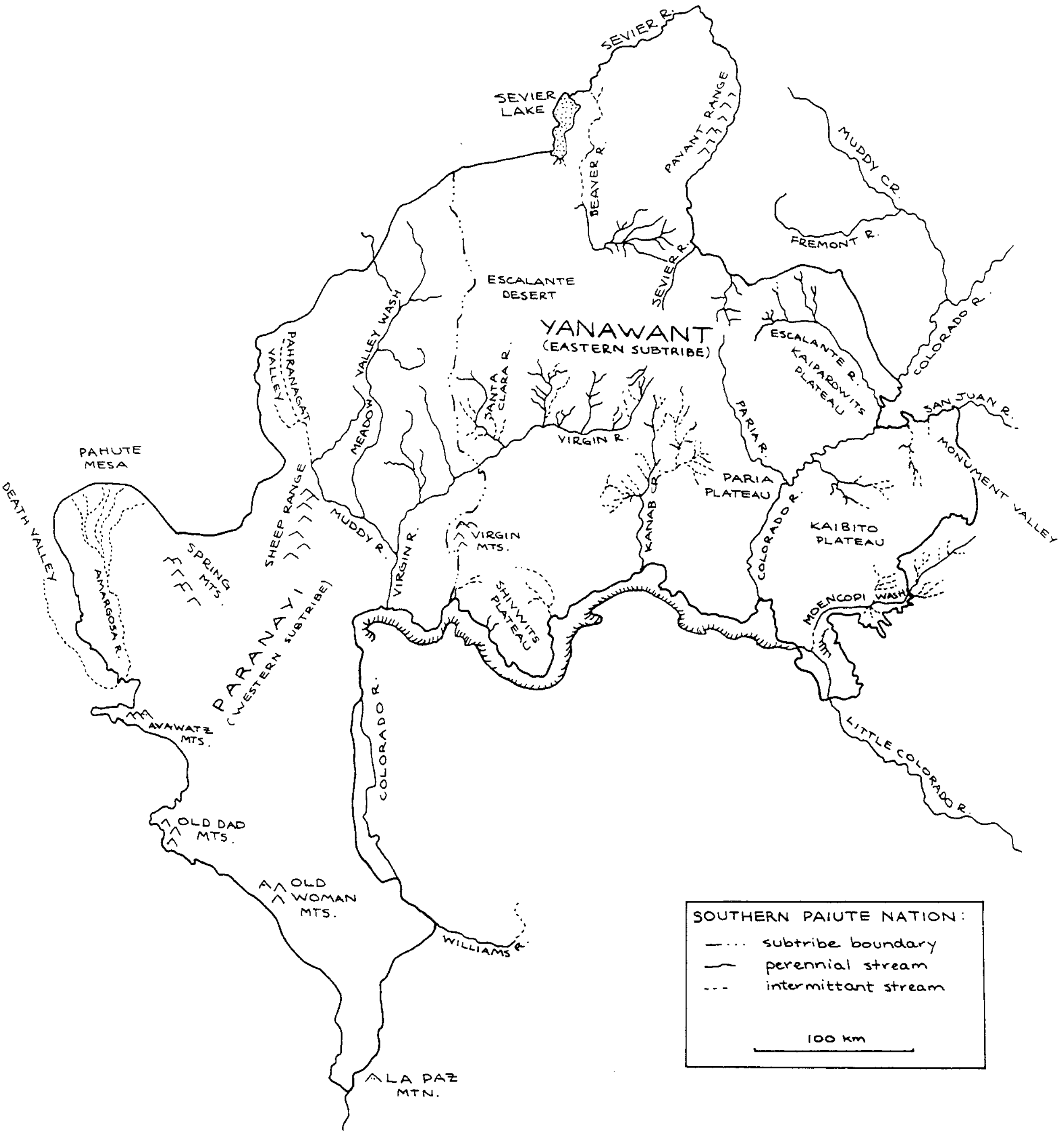


Figure 1.1. *Puxant Tuvip*: Southern Paiute holy land

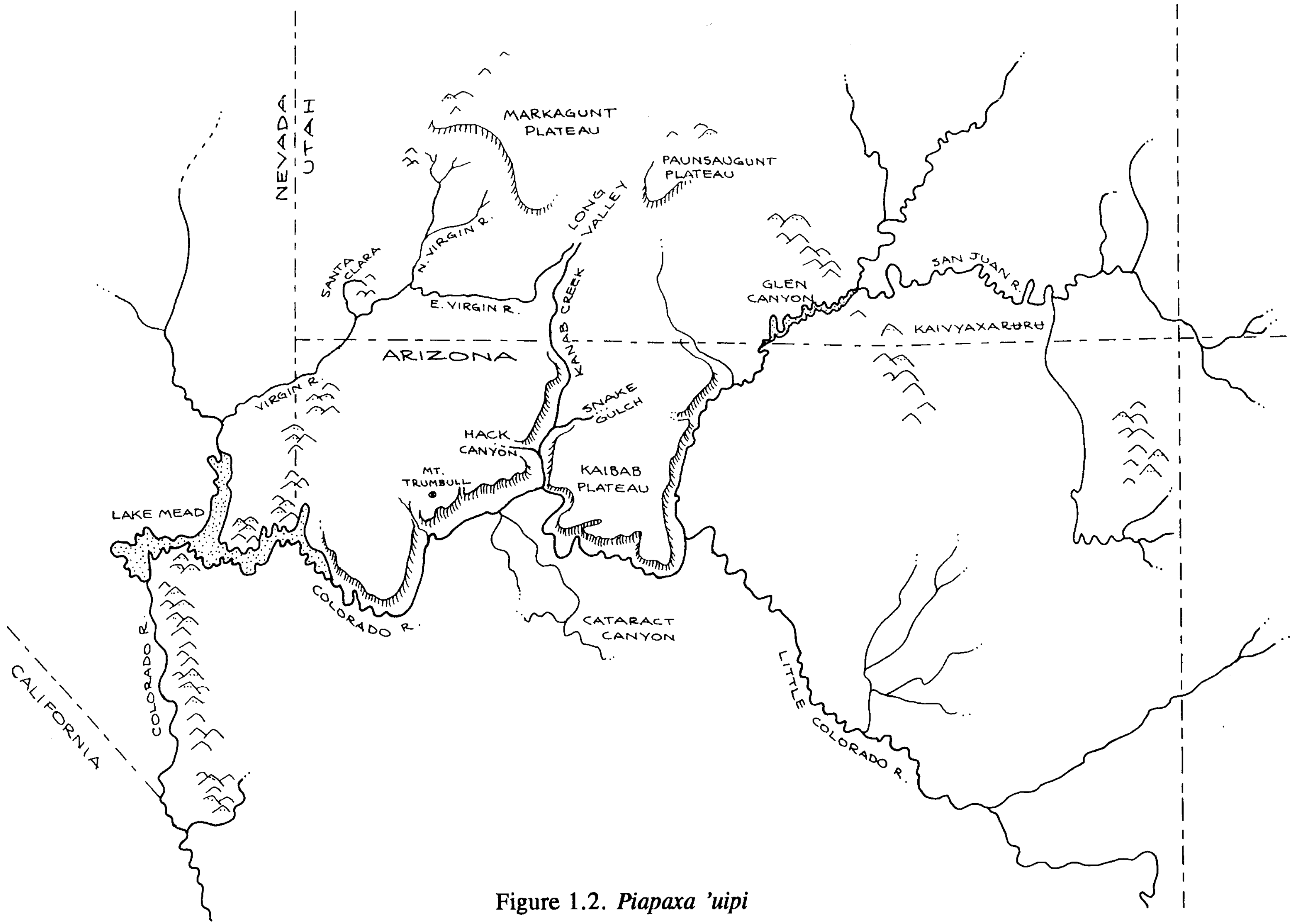


Figure 1.2. *Piapaxa 'uipi*

has provided all of these American Indian people with funds to participate in the GCES studies and, where possible, they have become deeply involved. Each of these American Indian tribes has become a Cooperating Agency in BOR consultations regarding the operation of Glen Canyon Dam.

Southern Paiute ethnographic studies initially involved officially appointed representatives from the Kaibab Paiute Tribe, the Paiute Indian Tribe of Utah (PITU), which is the composite government for five tribes, and the San Juan Southern Paiute Tribe. PITU is a very special component in this project because it represents the formerly independent Koosharem Paiutes, Kanosh Paiutes, Indian Peaks Paiutes, Cedar City Paiutes, and Shivwits Paiutes. Because PITU is a composite government, consulting with PITU brings the cultural insights from many Paiute groups at the same time it identifies the specific cultural concerns of any the five tribes. For this project, the BOR expressed the desire to interact primarily with the Shivwits Paiute tribe, and the PITU government has responded by selecting Shivwits cultural experts to participate in GCES ethnographic studies. Still, even though most interactions have been with Shivwits tribal representatives, the BOR is in a government-to-government relationship with PITU. This very complex relationship has been faciliated by two PITU chairs and tribal councils during the past four years.

The San Juan Southern Paiute tribe participated for two years in these studies, after which time tribal leaders found it impossible to continue participation despite strong continued concerns for their cultural resources in the *Colorado River Corridor*. The San Juan Southern Paiutes would like to reserve the right to re-enter these cultural resource discussions after pressing governmental business is resolved and government officials are once again available.

Beginning in 1993, and after the withdrawl of the San Juan Southern Paiutes from the project, the remaining Paiute governments agreed to a single point-of-contact between themselves and the BOR. The purpose of this new point-of-contact, called the Southern Paiute Consortium (SPC), was to provide more effective government-to-government interactions between the tribes and the BOR. The SPC functions much like a cultural resource office within a single tribe, except of course in this situation it represents multiple tribes. The SPC, through its Coordinator, has the authority to conduct business on behalf of these tribes, but it should be emphasized that government-to-government recommendations ultimately must be made by the Kaibab Paiute Tribe and the PITU.

Today, the SPC serves as a Cooperating Agency in the GCES program. As such, the SPC receives funds from the BOR for conducting basic research, assessing potential environmental impacts, developing monitoring procedures, and interacting with other Cooperating Agencies and the BOR. When needed, the SPC subcontracts for research services with the Bureau of Applied Research in Anthropology at the University of Arizona (BARA).

The Study Focus and Area

The focus of Southern Paiute ethnographic studies have been on the impacts of water that is released by Glen Canyon Dam. The Colorado River is one of the major factors influencing the riverine ecosystem that passes through Glen Canyon and Grand Canyon. The GCES studies have documented what this riverine ecosystem was before Glen Canyon Dam, what has happened to the ecosystem since Glen Canyon Dam was built, what kinds of impacts derive from various types of water release regimes, and what management strategies best protect the riverine ecosystem while still permitting the BOR to operate Glen Canyon Dam in an appropriate manner. The GCES studies have included both natural and cultural resources.

When water is released from Glen Canyon Dam it changes the behavior of the Colorado River. Some of the more basic changes involve how swiftly the river flows, how much sediment it carries, how rapidly it rises and falls, and its water temperature. These changes directly impact natural and cultural resources, such as plants, animals, minerals, and archaeology sites. These changes also indirectly impact natural and cultural resources in many ways. For example, the water moves or removes sand, affects plant communities, and changes the behavior of humans and other animals. Such effects are shown in Figure 1.3.

The study area for this project generally reaches from the bottom of the river bed to the highest point impacted by water released from Glen Canyon Dam. This study has come to be called the *Colorado River Corridor*. Technically, the *Colorado River Corridor* is composed of an *affected zone* and a *study area*. The *affected zone* includes all riverine environments, especially those that contain river derived sediments, whether alluvial, fluvial, or eolian. This zone encompasses the present beach up to and including the farthest extent of the old high water zone marked by high dunes and mesquite. The *study area* is the 255 mile stretch of this *affected zone* which includes all areas up to the 300,000 cubic feet per second water level and all sand covering areas above that level. These are technically accurate boundaries for studies about sediment movement and fish ecology, but they fail to sufficiently circumscribe other types of studies, especially American Indian studies.

American Indian study areas have been broadened to include places not directly touched by the Colorado River. The BOR has accepted tribal explanations of how places along the Colorado River are critically connected with other places elsewhere in what might be called the greater Glen Canyon and Grand Canyon region. Each American Indian Tribe has a culture that specially defines these relations, and each tribe has independently argued for exceptions to the BOR established study area boundary. For the Southern Paiutes these special connections have been explained in terms of cultural landscapes. Based on these arguments, the Southern Paiute study area was extended up two side canyons, Kanab Creek and Deer Creek, so that relevant information about the Grand Canyon and Colorado River as a single ecosystem could be added to the interpretation of the cultural signficance of Paiute resources found near the Colorado River. Selectively broadening American Indian study areas permits critical data to be added to the analysis and interpretation of cultural resources

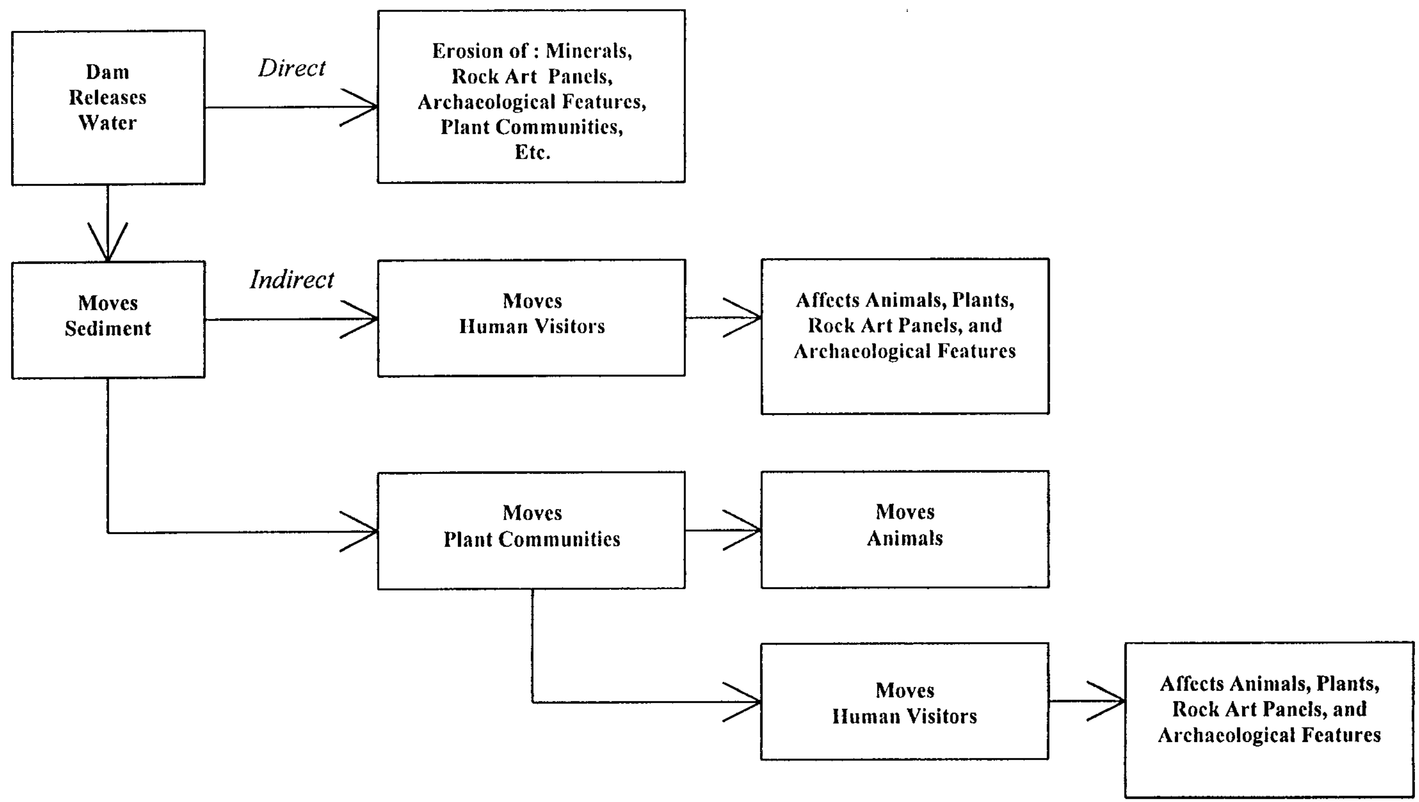


Figure 1.3. Example of direct and indirect impacts to cultural resources from Glen Canyon Dam

located along the Colorado River. These new data add to both the scientific validity and credibility of the findings.

Cultural Resources Studies

Since 1992, Southern Paiute representatives have been involved with (1) conducting systematic research on cultural resources in the *Colorado River Corridor*, (2) issuing reports summarizing research activities and providing management recommendations, (3) beginning the development of a cultural resource monitoring program, and (4) initiating a youth environmental education program.

Systematic Research

The SPC, with the assistance of the BARA, has identified and documented Southern Paiute ethnographic resources along the *Colorado River Corridor*. In order to most accurately convey the concerns of Southern Paiute people, data have been collected through a variety of methods including document searches, focus group interviews, and systematic individual interviews along the Colorado River. Research topics include ethnoarchaeology, ethnobotany, ethnofauna, rock art, and traditional cultural properties (TCPs) in this study area. Primary research tasks have included (1) consultation with tribal governments and agency officials, (2) a review of the legal history of Southern Paiutes in this region, (3) reviews of ethnohistoric and ethnographic documents, and (4) interviews with Southern Paiute elders and cultural resource specialists within the *Colorado River Corridor* and at their homes.

Written Reports

The Southern Paiute people have contributed their thoughts to three reports, including this one, that have been produced to summarize the findings of this systematic research and to provide management recommendations to the Bureau of Reclamation. These reports are:

> *Piapaxa 'uipi (Big River Canyon)* (Stoffle, Halmo, Evans, and Austin 1994) includes an overview of Southern Paiute culture, a legal review of the involved tribes and the Federal land management units within the study area, an ethnohistorical summary of Southern Paiute occupation of the study area and interactions with Euroamericans, the findings of the ethnoarchaeology and ethnbotany studies, and management recommendations.
>
> *Tumpituxwinap (Storied Rocks)* (Stoffle et al. 1995) includes a Southern Paiute interpretation of the study area, a discussion of rock art, a cultural landscape model for undertanding cultural resources, the findings of rock art studies along the Colorado River and in Kanab Creek, a discussion Southern Paiute TCPs in the study area, and management recommendations.
>
> *Itus, Auv, Te'ek (Past, Present, Future)* completes this series of reports and includes the findings of the ethnofaunal study, a discussion of options for Southern Paiute cultural

resource monitoring in the study area, the results of the initial development and field testing of the survey and monitoring program, a summary and discussion of the youth environmental education program, and a project summary and management recommendations for the future.

When viewed together, these reports provide a view of how Southern Paiute people used the lands and resources of the *Colorado River Corridor* in the past, a perspective on how these natural and cultural resources contribute to the contemporary lives of these Indian people, and a vision of how Paiute people can share their understanding of these resources with various federal agencies so that cooperative management of these resources can begin for future generations.

Cultural Resource Monitoring

Ongoing monitoring and evaluation site impacts are critical components of the Adaptive Management Program. The SPC will conduct regular monitoring trips into the *Colorado River Corridor* to observe and evaluate impacts to cultural resources there. Chapters Three and Four of this report are devoted to a thorough discussion of the basis for the Southern Paiute monitoring program and the results of the initial development and implementation of that program. The monitoring program has been linked to the GCES Geographic Information System (GCES-GIS), so GCES surveyors accompanied the SPC monitors into the study area to locate the sites of concern.

Youth Environmental Education

The BOR had ongoing consultation with American Indian tribes as Cooperating Agencies to the Glen Canyon Dam EIS and continues such consultation as part of the Adaptive Management Program. It is understood that the more each of the representatives who participate in these Cooperating Agency activities know about the *Colorado River Corridor* the more effective will be the consultation relationship. Experiential education has been a cornerstone of the BOR interaction with others since 1985 when the BOR arranged for an interagency trip through the Grand Canyon to discuss the GCES program (Wegner 1991:228). The SPC youth environmental education program is a continuation of that BOR committment to better policies through education. The SPC youth environmental education program has been designed to prepare Paiute youth to fulfill the SPC's responsibilities for adaptive management of the Glen Canyon Dam and its impacts. Chapter Five of this report describes the program and the results of its first year of implementation.

SUMMARY OF KEY FINDINGS

The first four years of Southern Paiute research in the *Colorado River Corridor* addressed a wide range of cultural issues, but these findings can be summarized in a few key points. Detailed information on how each of these findings was established is available in the appropriate report. Associated with these studies are general stipulations as well as resource-specific findings, so the following presentation uses these categories.

Paiute people have stipulated their attachment to traditional places and resources since first coming into contact with Euroamericans. This process began when Euroamericans first wanted something or wanted to live somewhere within Southern Paiute territory. From the beginning, Paiute people expressed ownership of or responsibility for protecting the place or resource. The most formal pronouncements of this type occurred during the Indian Claims Commission cases when Southern Paiutes had to go on record in a court of law regarding what was claimed as Southern Paiute (Sutton 1985) (Figure 1.4). The ICC process required that each Indian claim be officially challenged by Federal government experts. The results of the ICC, though criticized for ignoring areas that were jointly used by tribes, are useful for what they identify as tribal territory. They were produced in an advisorial and scholarly environment, so the findings have become the U.S. position regarding who held aboriginal lands at the time these lands were lost to the Federal government. The following stipulations are in keeping with those expressed by Southern Paiute people during the ICC hearings in Docket #122 and #145 and with cultural resource stipulations made over the past twenty years.

General Stipulations

* The Grand Canyon and more than 600 downstream miles of the Colorado River (from above the Kaiparowits Plateau to Blyth, California) exist within *Puxant Tuvip*, the holy land where Southern Paiutes were created.

* Aboriginally Southern Paiute people occupied almost 60% (317 of 540 miles) of the river bank of the *Colorado River Corridor.*

* *Piapaxa 'uipi*, which includes the Grand Canyon and the portion of the Colorado River that passes through it, is best studied and managed as a Southern Paiute regional cultural landscape.

* *Piapaxa 'uipi* is viewed by Southern Paiute people as a homeland to be used and lived in, rather than a wilderness to be conquered and dominated.

* *Piapaxa 'uipi* served as a region of refuge for Southern Paiute people during the late 1800s.

* The cultural resources contained within *Piapaxa 'uipi*, were culturally important, are culturally important, and will be culturally important to Southern Paiute people.

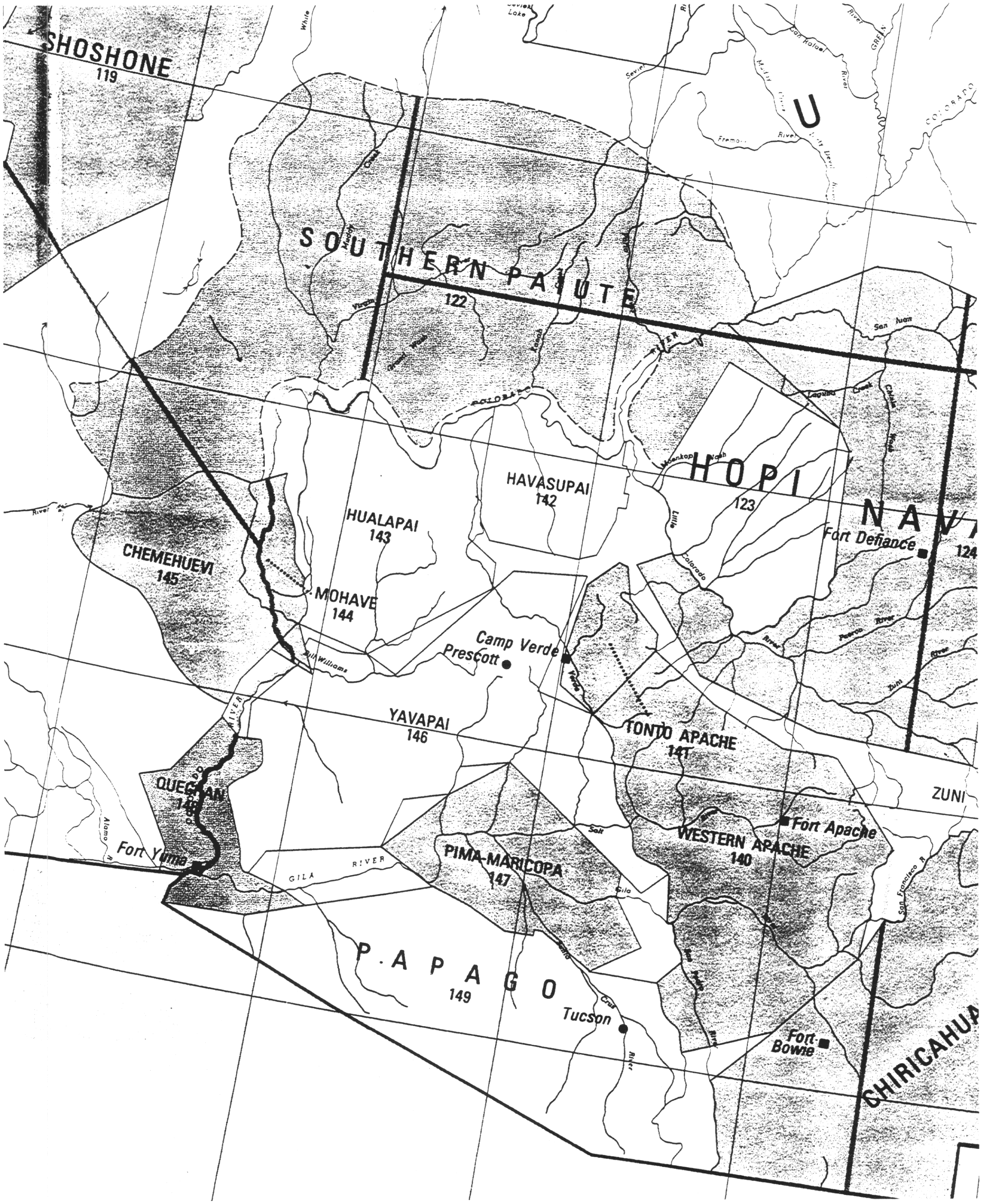


Figure 1.4. Southern Paiute Aboriginal Territory Identified by Indian Claims Commission

Tumpituxwinap (Storied Rocks) Findings

* *Tumpituxwinap* are one expression of the Southern Paiute relationship with the natural world. Placing symbols on a rock is a significant act that requires special religious preparation; consequently, all *Tumpituxwinap* have special meanings for Paiute people.

* Southern Paiute people believe that *Tumpituxwinap* sites both reflect and define the Grand Canyon as a cultural landscape.

* The Hualapai, Havasupai, and the Hopi used many *Tumpituxwinap* sites with Southern Paiute people. An example of this are the 1890 Ghost Dance sites near Pearce Ferry and upper Kanab Creek.

* The sacredness of the minerals used to place symbols on a rock is just as significant as the *Tumpituxwinap* itself because the minerals possess their own power and life force.

* The complexity of the *Tumpituxwinap* symbols is not an indicator of cultural significance. *Ompi* (red hematite paint) smudges reflect blessings on rock walls and are as culturally significant as elaborately drawn figures.

* A Southern Paiute rock painting style was identified for the first time by a professional rock art archaeologist during these studies.

Archaeology Findings

* Artifacts and the remains of dwellings reflect the fact that in the past whole families of Southern Paiutes lived along the Colorado River farming, gathering plants, hunting, trading with other Indian peoples, and conducting ceremonies.

* Southern Paiute people today view themselves as related to the people called by archaeologists the Virgin River Anasazi.

* In the past Southern Paiute people lived for long periods along the Colorado River as part of their normal way of life - it was central not marginal to them.

* Paiute people say that archaeology sites are locally interconnected up and down the Colorado River, and regionally interconnected as part of a system of trade and transhumant resource use.

* Some Paiute people continue to use sites along the Colorado River, although most people do not use sites because of changes in lifestyles and greatly reduced access.

* Paiute people have been taught about sites along the Colorado River and continue to teach new generations about these sites.

Plant Findings

* Of the ecozones closest to the Colorado River, the new riparian ecozone scored the highest in cultural significance based on the cultural significance of specific plants to Southern Paiute people.

* The vast majority of the 68 species of plants that were identified during the *Colorado River Corridor* interviews as being traditionally used for food, medicine, ceremony, construction, and other purposes are currently used for the same purpose.

* Younger generations continue to be instructed about the traditional uses of plants.

Animal Findings

* Animals living in the *Colorado River Corridor* were traditionally used for food, medicine, ceremony, clothing, tools, and other purposes, and most of them continued to be used today.

* Human impacts to animals, including those from the Glen Canyon Dam water releases, are complex and require careful study.

CHAPTER TWO

ETHNOFAUNA

Southern Paiute people have a special relationship with all animals living in their traditional holy land. They have an especially strong connection with animals living in the Grand Canyon along the Colorado River. This chapter begins an understanding of what the animals found along the *Colorado River Corridor* mean to Southern Paiute people today. The analysis is perceived as just a beginning because (1) the role of animals in Southern Paiute culture has not been well studied, (2) animals are perhaps the most difficult cultural resource to study, and (3) the *Colorado River Corridor* is a most difficult place to conduct a systematic study of animals.

Role of Animals In Paiute Culture

To understand the Southern Paiute meanings of animals found along the Colorado River, scientific questions about the cultural significance of animals must be translated into terms that make sense in Southern Paiute culture. To Southern Paiute people, animals exist in a number of culturally important contexts. The same animal may have very different meanings or roles in Southern Paiute culture depending on which context is being considered. In one context a *tavuts* (cottontail) is a source of food; in another context a *tavuts* is a spiritual being that was involved in shooting down the sun. In general, these cultural contexts can be grouped as periods of time.

In Southern Paiute culture, animals have existed in three very different periods of time during which the relations between humans and animals varied. The three major periods of time are (1) mythic time, (2) traditional time, and (3) contemporary time. The time period when animal and Paiute relations were established seems to have a major influence on the meaning of these animals for Southern Paiute people today.

Mythic Time

Mythic time occurred before Paiutes were created. Mythic time was when early forms of people and animals began their relationships. During mythic time, people behaved in many different ways; they were trying out various types of behaviors to see which were best suited for human life. Virtually all types of behaviors existed during this period; people even considered having children born in their upper arms. In mythic time, the world was new and there were few physical boundaries between rocks, plants, animals, stars, and people. Eventually, the divisions between things became distinct, certain types of human behaviors came to be viewed as wrong, and people who behaved in undesirable ways were turned into animals because of these behaviors. These animals then came to represent differences between right and wrong behavior. Creation stories involve these animals who embody the lessons Paiute people learned from the mythic time. For example, mythic time animals gave Southern Paiutes the bird songs, which are one set of songs used to sing the spirits of departed people to their place in the afterlife.

Traditional Time

Traditional time began when Southern Paiute people were created and a cultural birthright bond was established between them and their holy land. The point of creation was in the Las Vegas Wash located on the northeastern flank of *Nuvaxantu* (literally "where snow sits"), now known as Mount Charleston, which is located in the Spring Mountains near Las Vegas, Nevada. During traditional time, Paiute people maintained a sustainable balance between themselves and resources of their holy lands by repeating the creation stories and following their lessons. Traditional time ended when Euroamericans, their diseases, and their animals arrived in the Southern Paiute holy land.

Current Time

Current time exists in the memory of living Southern Paiute people. It is filled with their childhood and adult memories of stories about creation, tradition, and recent history, as well as their memories of personal interactions with animals. The current time memories of Southern Paiute people probably differ in many respects from stories that must have existed during traditional time. Sources of these memory changes include the fact that so many Paiute people died, so many animals were eliminated, and so much land was lost between these two periods. Euroamerican encroachment in the Southern Paiute holy land began with diseases and occasional visits in the late 1700s and became an onslaught of diseases, animals, and people by the 1850s. Disease and starvation not only killed many Southern Paiute people and disrupted their traditional way of life (Stoffle, Jones, and Dobyns 1995); tens-of-thousands of Euroamerican animals contributed to massive ecosystem damage, such as the channelization of Kanab Creek (Webb, Smith, and McCord 1992), and displaced or eliminated many Paiute animals by the 1880s.

After the arrival of Euroamericans, Paiute people became increasingly concentrated on smaller and smaller portions of their holy land. Dependency on wage labor in the late 1800s replaced selfsufficient farming, gathering, and animal hunting. By the early 1900s some animals were no longer accessible to Southern Paiutes, and by the mid-1900s Federal and state game animal laws placed many more animals beyond the reach of Paiute people. Current time animal memories, such as the ones recounted during this study, tend to concentrate on those animals found where living Paiute people have grown up and worked.

Difficulty of Animal Studies

The impacts of human activities on animals are among the most difficult of American Indian cultural resource topics to study. This derives from a number of factors, at least three of which affected this study. First, animals often are not present when researchers arrive in an area. Second, animals often have large territories, only a portion of which may be potentially impacted by human activities. When it is clear that some impacts are occurring to a portion of an animal's territory, it often is difficult to establish whether or not that area is critical habitat or habitat that can be eliminated without seriously affecting the animal. Third, animals may be present but sleeping when researchers are in an area. Nocturnal animals are difficult to study because they avoid human contact and are around when they are least visible to humans.

Animals in the Colorado River Corridor

The *Colorado River Corridor* presents a physical challenge to any study, but it is even more challenging for the study of animals. Travel by raft along the Colorado River demands a level of predictability in order to plan daily stops and assure sufficient distances are travelled. Animals, on the other hand, are by their very nature difficult to predict. Eagles are common at Nankoweap during certain seasons, but even then they may be seen one day but not another. Beaver exist in many places along the river, but they may be hiding in their lodges at any given time because river travelers who passed before appeared to pose a threat and caused them to hide. Deer or mountain sheep may be observed at a place where it is impossible to stop the raft, like just before a rapid. Ringtail cats show up unpredictably on a cliff at the back of a camp in the middle of the night.

Unlike plants, archaeology sites, and mineral deposits, animals are often just not there when researchers arrive at a preplanned stop, so it is necessary to conduct most animal interviews by using photos of animals known to be living along a section of river. When the animals are observed and the river and schedule permit the raft to stop, then it is possible to conduct an interview while observing (or soon after observing) the animal.

Connecting animals with their habitats is difficult along the Colorado River because the study area contains special habitats not found elsewhere. Adapting to these special habitats has often caused the behavior of the animals to be different, and this creates an unusual problem for Paiute people evaluating potential impacts. For example, most Paiute people are accustomed to interacting with beavers that live along quiet streams where they make lodges and dams. Such an adaption is impossible along the Colorado River, so the beavers live in the banks of the river. Floods that would have adversely impacted quiet-stream-adapted beavers seem to have few adverse impacts on Colorado River bank-dwelling beavers. On the other hand, human river travelers use the limited sandy banks along the Colorado River for day and evening camps, thus potentially impacting bank-dwelling beavers in ways that would be uncommon for quiet-stream-adapted beavers. It is necessary for Southern Paiutes to become aware of special Colorado River habitats where the animals live so they can fully evaluate the habitat impacts of Glen Canyon Dam water releases.

METHODOLOGY

There are many possible approaches to identifying the cultural significance of animals located along the Colorado River Corridor and how these are potentially impacted by the operation of Glen Canyon Dam. The first and most important approach is to conduct *Colorado River Corridor interviews* with Southern Paiute elders while they observe the animals, animal habitats, and dam impacts along the Colorado River. A second approach to understanding the cultural significance of animals is to use Paiute animal statements shared during *historic animal interviews* and compare these statements with those from contemporary animal interviews. Information on Southern Paiute animals began to be systematically collected in the 1870 by John Wesley Powell, continued to be collected by Palmer in the 1890s, was collected by Omer Stewart, Isabel Kelly, and C. Hart Merriam in the 1930s, and has been a small but important part of environmental impact studies conducted since 1977 by the UofA research team. All of these sources of information are used in this chapter to supplement and help place into context the expressed cultural concerns of Southern Paiute elders regarding animals in the *Colorado River Corridor.*

Colorado River Corridor Interviews

The most important source of information about Southern Paiute concerns about animals derives from interviews conducted along the banks of the Colorado River. The ethnofaunal study raft trip began on April 5, 1995 at Lees Ferry and ended on April 17, 1995 at Pearce Ferry. The trip was divided into three phases. The first phase of the trip took place from April 5 - 10 between Lees Ferry and National Canyon. The second phase of the trip took place from April 10 - 15 between National Canyon and Diamond Creek. The third phase of the trip took place from April 15 - 17 between Diamond Creek and Pearce Ferry. Due to resource constraints, the ethnofaunal study raft trip was combined with an opportunity for members of the Kaibab Paiute Tribal Council to visit the study area to discuss Southern Paiute research that has been conducted in the study area and a joint Southern Paiute-Hualapai venture on the Colorado River between National Canyon and Pearce Ferry. The ethnofaunal study was conducted during the first and second phases of the trip (see Table 2.1). The impact of time constraints on the study results are discussed later in this chapter.

Animals known to live within the study area were identified prior to the trip. Mammals, birds that nest within the study area, reptiles, amphibians, and fish that are common or abundant within the *Colorado River Corridor* were selected to be included on the Ethnofaunal Study List. All large mammals, any animals that are known to have been extirpated from the study area, and threatened or endangered animals were added to the Study List. Invertebrates identified as particularly notable were added to the Study List. Animal occurrence and distribution were determined using *Mammals of the Grand Canyon* (Hoffmeister 1971); *Mammals of the Arizona Strip Including Grand Canyon National Monument* (Hoffmeister and Durham 1971); *Grand Canyon Birds* (Brown, Carothers, and Johnson 1987); *Amphibians and Reptiles of the Grand Canyon National Park* (Miller, Young, Gatlin, and Richardson 1982); "Native Fishes of the

Table 2.1. Schedule of *Colorado River Corridor Interviews*

April 5, 1995	Depart Lees Ferry	Mile 0
	Camp #1 - North Canyon	Mile 20.5
April 6, 1995	Interview Stop #1 - North Canyon	Mile 20.5
	Camp #2 - Nankoweap Canyon	Mile 52
April 7, 1995	Interview Stop #2 - Nankoweap Canyon	Mile 52
	Stop - Salt Mine	Mile 64
	Camp #3 - Rattlesnake Camp	Mile 75
April 8, 1995	Interview Stop #3 - Rattlesnake Camp	Mile 75
	Camp #4 - below Fossil Canyon	Mile 125
April 9, 1995	Camp #5 - National Canyon	Mile 166.5
April 10, 1995	Interview Stop #4a - National Canyon	Mile 166.5
	Camp #6 - National Canyon	Mile 166.5
	Joint Meeting #1 - National Canyon	Mile 166.5
April 11, 1995	Interview Stop #4b - National Canyon	Mile 166.5
	Camp #7 - Vulcan's Anvil	Mile 178
	Joint Meeting #2 - Vulcan's Anvil Camp	Mile 178
April 12, 1995	Joint Meeting #3 - Visit to Vulcan's Anvil	Mile 178
	Interview Stop #5 - Vulcan's Anvil Camp	Mile 178
	Stop - Prospect Canyon - Overview	Mile 179
	Camp #8 - Whitmore Wash	Mile 188
April 13, 1995	Paiute Group Interview #1 - Whitmore Wash	Mile 188
	Joint Meeting #4 - Visit to Hematite Cave	Mile 200
	Stop - Spring Canyon - View effects of flood	Mile 204
	Camp #9 - Granite Park	Mile 209
April 14, 1995	Interview Stop #6 - Granite Park	Mile 209
	Paiute Group Interview #2 - Granite Park	Mile 209
	Paiute Group Interview #3 - Pumpkin Springs	Mile 213
	Camp #10 - 224 Mile Canyon	Mile 224
April 15, 1995	Interview Stop #7 - 224 Mile Canyon	Mile 224
	Lunch - Diamond Creek - Hosted by Hualapai	Mile 226
	Kaibab Paiute Tribal Council Meeting #1	Mile 246
	Camp #11 - Spencer Canyon	Mile 246
April 16, 1995	Kaibab Paiute Tribal Council Meeting #2	Mile 246
	Camp #12 - Pearce Ferry	Mile 280
April 17, 1995	Take Out and Depart - Pearce Ferry	Mile 280

Grand Canyon Region: An Obituary?" (Minckely 1991); *The Colorado River Through the Grand Canyon* (Carothers and Brown 1991); *The Colorado River in Grand Canyon: A Guide* (Stevens 1993); and personal communication with biologists who have worked in the study area. In addition, animals living in the study area for which Paiute names had been provided in *Puaxant Tɨvip: Utah Indians Comment on the Intermountain Power Project, Utah Section of Intermountain-Adelanto Bipole I Proposal* (Stoffle and Dobyns 1982), *Anthropology of the Numa* (Fowler and Fowler 1971), and *The Chemehuevis* (Laird 1976) were added to the Study List. The resulting initial Ethnofaunal Study List included 28 mammals, 10 reptiles, 2 amphibians, 24 birds, 10 fish, and 11 invertebrates (see Appendix A).

Photographs and/or black-and-white line drawings were collected for all the animals on the Study List and organized into animal reference photo notebooks. The Arizona Sonora Desert Museum in Tucson loaned color slides and allowed prints to be made of 47 of the animals on the Study List. Additional photos and sketches were obtained from field guides for mammals, birds, reptiles, and insects of the Grand Canyon and southwest. The ethnographers carried interview forms, the animal photo notebooks, and field guides to conduct interviews.

An interview form was developed to record information about each animal (see Appendix B). This form was initially adapted from the ethnobotany form and animal forms used with Southern Paiutes and other American Indian people in other places. The form was piloted for use in the *Colorado River Corridor* during the 1994 rock art studies and revised prior to the April 1995 river trip. Data about animals were collected during both individual and group interviews. The format of these interviews is described below.

Individual Interviews

During the river trip, individual animal interviews were conducted at selected stops along the *Colorado River Corridor*. The stops were chosen to include the Marble Canyon transitional zone, Sonoran Desert, and Mojave Desert - these are the three major ecosystems found within the study area. Only sites near the banks of the Colorado River were visited. Southern Paiute tribal representatives were encouraged to watch for animals and signs of animal presence while riding on the rafts and when stopped on the beaches. The Southern Paiute Consortium photographer and two University of Arizona ethnographers took pictures of the animals and the signs, whenever possible. Also, several representatives brought along their own cameras and tape recorders to record their experiences and ideas.

Along the river, the Southern Paiute consultants were interviewed individually by the trip ethnographers according to the following steps:

> * The Southern Paiute consultant was shown an animal photo notebook. The individual was asked to pick out the animals that had been sighted that he or she would like to talk about. If no new animals or animal signs had been seen since the previous interview, the consultant was asked to select an animal from the notebook that he or she would like to talk about.

* The Southern Paiute consultant provided information about the significance of the animal in Paiute culture through a formal interview process. While looking at the picture of the animal, and using it to point out body parts or other significant features being discussed, the consultant described the relationship between the animal and Southern Paiute people. An ethnographer recorded each individual's observations and interpretations on an Ethnobiology-Animals Interview Form (see Appendix B). Forms were used to insure that the responses were systematically recorded from all Paiute representatives for all animals. A tape recorder was available at all times in case the representatives wished to further comment on an animal.

In several cases, a consultant elected to complete an interview on an animal that was not included on the initial Ethnofaunal Study List. If the animal occurs in the *Colorado River Corridor*, its name was added to the Ethnofaunal Study List.

Group Interviews

Group interviews were conducted with Southern Paiute consultants to verify the Paiute names for animals identified on the trip and to gain additional information about the animals. Group animal interviews were organized around the animal photos and drawings included in the animal photo notebooks. Southern Paiute consultants were shown each animal photo and asked to provide a Paiute name for the animal. Field guides were used for animals that had been identified on the trip but were not included in the animal photo notebook and to clarify whether a Southern Paiute name referred to a single species or a larger group of animals, such as mice. Southern Paiute consultants also shared stories or information about the animals during this time. These discussions were recorded and enriched the information gained from the individual interviews. However, due to time constraints, the consultants participated in group interviews about only mammals and birds. In the future, additional interviews will be required for the other animals.

Historic Animal Interviews

Non-Indian people have observed and tried to learn about Southern Paiutes' relationship to and interactions with animals since the earliest travelers passed through their land. In 1776, Father Escalante observed that Paiute people ate ants and hunted deer, and, in 1825, the trapper Jeddidiah Smith noted the difference between beaver dams and human irrigation dams along the Santa Clara River. These travel accounts are useful for beginning to provide a historic context for contemporary Southern Paiute animal concerns. Unfortunately, these accounts were not efforts to systematically document Paiute animal values.

The systematic study of Paiute animals by John Wesley Powell began in the late 1860s and continued throughout the 1880s (Fowler and Fowler 1971; Fowler and Matley 1979). Powell collected information and artifacts from among most Southern Paiute groups living in Nevada, Utah, and Arizona, but his activities tended to focus on Paiute people living in and around the Grand Canyon. Powell's collections of material artifacts then in use by the Paiute people reflected his attempts at completeness (Fowler and Matley 1979:1). Given that Powell had a similar interest in Southern Paiute language, we can expect that his animal lists reflect his concern that these too be as complete as possible. Thus Powell provides the earliest opportunity to better understand by comparison contemporary Southern Paiute animal concerns.

Edward Sapir worked with Tony Tillohash, a native speaker of Paiute, at the Carlisle Indian School in Pennsylvania in 1910. Part of their project was a Paiute lexicon, which includes many terms for plants and animals. This is published in Sapir (1931).

Between 1909 and 1936, C. Hart Merriam conducted face-to-face interviews with Kaibab, Pahrump, Las Vegas, Moapa, Shivwits, and San Juan Paiute people (Merriam 1979). The interviews occurred around a common set of animal photographs developed as a means of gathering animal names. The Southern Paiute people who were interviewed were not named; the only information provided is that they were (1) Ki-vav´-vit recorded at Moccasin Spring, Arizona June 24-25, 1932, (2) Nŭ-vah´-ahn-dit recorded at Ash Meadows, Las Vegas, and Moapa, Southern Nevada November 1909, December 1919, and April 1931, (3) Siv-vits recorded at Santa Clara Valley, Utah June 26-27, 1932, and (4) Pi´-yuts Neuwants (San Juan Paiutes) recorded at Yu-ving-´ah, Little Colorado Desert, Arizona October 8-9, 1936.

FINDINGS

Table 2.2 presents all the animals on the final Ethnofaunal Study List and whether or not any data, either contemporary or historical, were collected about that animal during this study. Three types of data were systematically collected for the study: (1) contemporary and historic Southern Paiute animal names, (2) mythic, traditional, and contemporary meanings of animals for Southern Paiutes, and (3) issues identified by contemporary Southern Paiutes regarding the management of the animals and their habitats in the *Colorado River Corridor*. The following sections are organized to describe each of these types of data.

Southern Paiute Animal Names

Things that are named possess at least the most basic level of cultural significance - they are recognized. Faced with far more environmental information than can be perceived or processed by limited human perceptual and cognitive systems, selective recognition of environmental features is a must. Those elements of the environment that are interesting and important are most likely to be recognized. The degree of specificity of animal names at the species, genus, or other level of biological classification provides information about the cutural significance of the object being named. For example, local species that have limited cultural importance tend to be lumped together or under-differentiated (according to biological classification). Thus, whether or not an animal is named offers a first measure, albeit limited, of cultural significance (Berlin 1978, Hunn 1982, Hays 1982).

Table 2.2. Data Available for Animals on the Final Ethnofaunal Study List

Scientific Name	Common Name	Colorado River Interviews		Historic Interviews		
		Indiv.	Group	Merriam	Powell	Sapir
MAMMALS						
Ungulates and Carnivores						
Antilocapra americana	Pronghorn Antelope	X	X	X	X	X
Bassariscus astutus	Ringtail			X		
Canis latrans	Coyote	X	X	X	X	X
Canis lupus	Wolf		X	X	X	X
Erethizon dorsatum	Porcupine	X		X	X	X
Felis concolor	Mountain Lion	X	X	X	X	X
Lutra canadensis sonora	River Otter			X		
Lynx rufus	Bobcat		X	X	X	X
Odocoileus hemionus	Mule Deer	X	X	X	X	X
Ovis canadensis	Desert Bighorn Sheep	X	X	X	X	X
Pecari angulatus	Collared Peccary					
Procyon lotor	Raccoon			X		X
Spilogale putorius	Western Spotted Skunk		X	X		
Taxidea taxus	Badger		X	X	X	X
Urocyon cinereoargentatus	Gray Fox		X	X	X	X
Rodents and Others						
Ammospermophilus leucurus	White-tailed Antelope Squirrel			X		X
Castor candensis	Beaver	X	X	X	X	X
Cynomys gunnisoni	Prairie Dog	X	X		X	X
Eutamias dorsalis	Cliff chipmunk		X			
Eutamias sp.	Chipmunk			X	X	X
Lepus californicus	Black-tailed Jack Rabbit	X	X	X	X	X
Neotoma lepida	Desert Woodrat					
Neotoma albigula	White-throated Woodrat		X			

Scientific Name	Common Name	Colorado River Interviews		Historic Interviews		
		Indiv.	Group	Merriam	Powell	Sapir
Neotoma sp.	Woodrat			X		X
	Mountain Rat				X	
Ondatra zibethica	Muskrat					
Perognathus intermedius	Rock Pocket Mouse					
Perognathus sp.				X		
Peromyscus crinitus	Canyon Mouse		X			
Peromyscus eremicus	Cactus Mouse		X			
Peromyscus sp.	Mouse	X		X		X
Pipistrellus hesperus	Western Pipistrelle	X	X	X		X
Citellus spilosoma	Spotted Ground Squirrel					
Sylvilagus audubonii	Desert Cottontail	X	X	X	X	X
REPTILES						
Lizards						
Cnemidophorus tigris	Western Whiptail					
Coleonyx variegatus	Banded Gecko					
Crotaphytus bicinctores	Black Collared Lizard			X		
Heloderma suspectum	Gila Monster					
Sauromalus obesus	Chuckwalla	X		X		X
Sceloporus magister	Yellow-backed Spiny Lizard			X		
	Lizard	X			X	X
Snakes						
Crotalus atrox	Western Diamondback Rattlesnake			X		
Crotalus viridis abyssus	Grand Canyon Rattlesnake			X		
Crotalus sp.	Rattlesnake			X	X	X
Lampropeltus getulus	California Kingsnake					
Pituophis melanoleucus	Gopher Snake	X		X		

Scientific Name	Common Name	Colorado River Interviews		Historic Interviews		
		Indiv.	Group	Merriam	Powell	Sapir
AMPHIBIANS						
Bufo punctatus	Red-spotted Toad					
Bufo sp.	Toad			X	X	X
Rana pipiens	Northern Leopard Frog	X				
Rana sp.	Frog			X		X
BIRDS						
Aeronautes saxatalis	White-throated Swift					
Amphispiza bilineata	Black-throated Sparrow		X			
Anas platyrhynchos	Mallard Duck	X	X	X	X	X
Aphelocoma coerulescens	Scrub Jay		X			
	Jay			X	X	X
Aquila chrysaetos	Golden Eagle		X	X		
Archilochus alexandri	Black-chinned Hummingbird	X	X			
	Hummingbird			X	X	X
Athene cunicularia	Burrowing Owl		X	X		
Bubo virginianus	Great Horned Owl	X	X	X	X	X
Buteo jamaicensis	Red-tailed Hawk	X	X	X	X	X
Callipepla gambelii	Gambel's Quail	X	X			
	Quail			X	X	X
Campylorhunchus brunneicapillus	Cactus Wren					
Troglodytes sp.	Wren			X		
Carpodacus mexicanus	House Finch					
Cathartes aura	Turkey Vulture		X	X	X	X
Chordeiles acutipennis	Lesser Nighthawk		X	X		X
Colaptes auratus	Flicker	X	X	X	X	X
Corvus corax	Common Raven		X	X	X	X
Falco peregrinus	Peregrine Falcon					

Scientific Name	Common Name	Colorado River Interviews		Historic Interviews		
		Indiv.	Group	Merriam	Powell	Sapir
Grus mexicanus	Sand Hill Crane			X		
Grus sp.	Crane	X			X	X
Haliaeetus leucocephalus	Bald Eagle	X	X	X		
	Eagle				X	X
Lanius ludovicianus	Loggerhead Shrike			X		
Larus delawarensis	Ring-billed Gull					
Larus sp.	Gull		X	X		X
Meleagris gallopavo	Wild Turkey	X	X			
Mimus polyglottos	Northern Mockingbird		X	X		
Passerinea cyanea	Indigo Bunting		X			
Salpinctes obsoletus	Rock Wren	X		X		
Zenaida macroura	Mourning Dove	X	X			
	Dove			X	X	X
FISH						
Catostomus sp.	Sucker					X
Cyprinodon carpio	Carp					
Gila cypha	Humpback Chub					
Gila elegans	Bonytail Chub					
Pimephales promelas	Fathead Minnow					
Ptychocheilus lucius	Colorado Squawfish					
Rhinichtys osculus	Speckled Dace					
Oncorhynchus mykiss	Rainbow Trout					
Salvelinus fontinalis	Brook Trout					
	Trout	X			X	X
Xyrauchen texanus	Razorback Sucker					
INVERTEBRATES						
Latrodectus mactans	Black-widow Spider					

Scientific Name	Common Name	Colorado River Interviews		Historic Interviews		
		Indiv.	Group	Merriam	Powell	Sapir
Order Diptera	Fly			X	X	X
Pheidole sp.	Harvester Ant					
	Ant			X	X	X
	Louse			X		
Family Culcidae	Mosquito			X	X	X
Family Pentatomidae	Stink Beetle				X	X
Centruroides exilicauda	Straw-colored Bark Scorpion					
Order Scorpionida	Scorpion			X		
Lycosa sp.	Tarantula			X		
Dasymutilla sp.	Velvet Ant					
Oxyloma haydeni kanabensis	Kanab Amber Snail					

Name changes also provide information about the importance of different elements in the environment within a culture. Using a four level scale of cultural significance, Berlin, Breedlove, and Raven (1973) found that names for more significant plants changed more rapidly than others. Another goal of such ethnoscience is to be able to use the relationships between changes in the content of naming systems and changes in the patterns of resource use to understand defunct ecological patterns. Such folk biological knowledge, stored in the memories of individuals who have survived acculturation, can be used to look back in time at patterns that once existed (Hunn 1982).

Both cultural significance and information about previous ecological patterns are necessary for effective Southern Paiute decision making regarding the impacts of Glen Canyon Dam on the *Colorado River Corridor*. The consistency and change in Southern Paiute animal names provides a means of understanding the role of particular animals in Southern Paiute culture. Table 2.3 shows historic and contemporary names for the animals on the Ethnofaunal Study List. The animals have been alphabetized by genus and species because the naming task in the Colorado River interviews required consultants to view and name particular species of animals that were included in the Ethnofaunal Study List.

As the data in the Table 2.3 show, there is a general Paiute tendency for naming animals as generics, fairly broad categories that do not distinguish among species or sometimes even genera: deer, fish, bird, eagle, dove, quail, duck, squirrel, and frog/toad. Therefore, some of the animals that have identical Paiute names do not appear together in the table. This tendency is consistent with the findings of ethnobiological studies. Genus appeared in the development of a global biological classification system as a means of organizing an unmanageable number of

Table 2.3. Historic and Contemporary Paiute Names for Animals on the Ethnofaunal List

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
			Mammals		
			Ungulates and Carnivores		
Antilocapra americana	Pronghorn Antelope	Won´-sits (k) Wants (lv)	Wants	Wahntz (k) Wahn-ze (s) Wongs (sj) Waknch (n)	Wants
Bassariscus astutus	Ringtail			Kah-goots (s)	
Canis lupus	Wolf	Shin-au´-av (k) Shin-av (lv)	Avatɨsɨnav Avatɨsinav Avatɨngkwinorats Piasɨnav Piasinav Sɨnavu Sinavɨ Tɨvatsi	Ah-vaht Se-nav (k) Pe-ah Sin-nav (s) Ah-vaht-ah Se-nav (sj) Sin-na-ab (n)	Piasɨnav
Canis latrans	Coyote	Yo-go-wo´-tsi (k)	Yoxovwits Yoxovɨtsi Sɨnangwavi Tɨrasɨnav Tɨrasinav	Yo-go-bits (k) Sin-nav (s) Shin-nah-ab (sj)	Tɨrasɨna'av
Erethizon dorsatum	Porcupine		Yɨngɨmpɨtsi	Ye-num-puts (k) Ye-hum-puts (s) Ye-num-puts (sj) Yu[ch] (n)	
Felis concolor	Mountain Lion	Tu-ma´-mu-ints (lv)	Tukumumutsi Piaruku	'Kummo-muts (k) Too-koo-puts (s) To-ko-mo-muts (sj) Too-koo-mo-munch (n)	Piaruk

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
Lutra canadensis sonora	River Otter			Na-puts (sj)	
Lynx rufus	Bobcot, Wildcat				Tukupʉts
Lynx sp.	Bobcat, Wildcat	To-ko´-puts (k) Tŏk (lv)	Tukutsi Tukupʉts	Too-koo-puts (k) Took (s) Took (n) Mo-sahts (sj)	
Odocoileus hemionus	Mule Deer			Tu-e (k) Tu-we-ah (s) Yu-oo-e (sj) Too-hoo-e (n)	Tʉxia
Odocoileus sp.	Deer	Ti´-ats (k) Tu-i (lv)	Tʉxia		
Ovis canadensis	Desert Bighorn Sheep	Na´-guts (k) Na´-k^w (lv)	Naaxa	Nahk (k) Nah^{ch} (s) Nahk (sj) Nah-gah (n)	Naax
Pecari angulatus	Collared Peccary				
Procyon lotor	Raccoon		Yamasat	Yah-mas-set (k) Yah-mah-sit (s) Tah-vi tre-ahnt (sj) Yah-mah-sah (n)	
Spilogale putorius	Western Spotted Skunk			Kah'bo-ne (k) Kah Bo-na (s) Kah-bo-na (n)	
--	Skunk	Pu´-ni (k)	Poni'a	Po-ne (k) Po-na (s) Po-ne-ets (n)	Poni'

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
Taxidea taxus	Badger	Hūn (lv)	Ʉnampʉtsi	Un-nam-but (k) Hoon (s) To-chi-e (sj) Hoon (n)	Ʉnampʉts
Urocyon cinereoargentatus	Gray Fox	Hú-pats (k) Un-si´-ats (k) Hunt-si´ (lv)	Tavangwaimpitsi	Sah-vi-puts (k) Sin-nants (s) Tah-vahn-set (sj) Hon-za (n)	Onsi'its Onsi'ikarum
		Rodents and Others			
Ammospermophilus leucurus	White-tailed Antelope Squirrel		Tava'atsi	Tav-vat (k) Ta-bats (s) Ta-vats (n)	
Castor candensis	Beaver	Pa´-wints (k) I-pi´-na (lv)	Paachuku Paontsi Pa'ʉxutsi	Pah wints (k) He-pe-nah (n)	Pa'ʉxuts
Citellus spilosoma	Spotted Ground Squirrel				
Citellus sp.			O'itsitsi	Aw-oi-chits (k) Ki-vah skoots (s) Skwe-ets (n)	
(*Sciurus aberti*)	Kaibab Squirrel		Kaivaskuts		Kaivaskuts
--	Squirrel	Skāts (k) O-'gun´-to-ats (k) Si-kuts´ (lv)	Sikuts Skuts		Sikuts Skuts
Cynomys gunnisoni	Whitetail Prairie Dog		Aiyavats		Aiyavʉts
Eutamias dorsalis	Cliff Chipmunk				
Eutamias sp.	Chipmunk	Ta-vwōts (k) O'gun´-to-ats (k) O´-i-chots (lv)	Oxontava'atsi Tava'atsi Tavarungkwits	Oi-chits (k) O-gon tav-vah-ats (sj) Ho-a-tsits (n)	Tavarungkwits

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
Neotoma albigula	White-throated Woodrat				
Neotoma lepida	Desert Woodrat				
Neotoma sp.	Woodrat (round tail)		Kaatsi	Kaht (k) Kats (s) Kahts (n)	Kaats
	Mountain Rat	Kats (k) Kāts (lv)			
Ondatra zibethica	Muskrat	Pa-ru´-vwa-tats (k)			
Perognathus intermedius	Rock Pocket Mouse				
Perognathus sp.	Pocket Mouse			Pi-im-buts (k)	
Peromyscus crinitus	Canyon Mouse				
Peromyscus eremicus	Cactus Mouse				
Peromyscus sp.	Mouse			Poo-e-chet (k) Poo-e-tsets (s) Poo-e-chet (sj) Poo-in-chets (n)	
--	Mouse		Pu'ichats		Pu'ichats
Lepus californicus	Black-tailed Jack Rabbit	Ka-mu (k) Kam (k) Kām (lv)	Kaamʉ	Kahm (k) Kahm (s) Kahm (sj) Kahm (n)	Kaam
Sylvilagus audubonii	Desert Cottontail	Ta-vwōts´ (k) Ta-vōts (lv)	Tavutsi	Tah-wuts (k) Tah-boots (s) Tah-vuts (sj) Ta-voots (n)	Tavuts
--	Rabbit	Tsok-um (k)			

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
Pipistrellus hesperus	Western Pipistrelle				
--	Bat		Pacha'ats	Pa-tsats (k) Pat-sats (s) Pah-chats (sj) Pats-ats (n)	Pacha'ats
		Reptiles			
		Lizards			
Cnemidophorus tigris	Western Whiptail				
Coleonyx variegatus	Banded Gecko				
Crotaphytus insularis bicinctores	Black Collared Lizard				
Crotaphytus collaris baileyi	Western Collard Lizard			Kan-ne moi-kar-rat (k) Tom-po-tsat (n)	
Heloderma suspectum	Gila Monster				
Sauromalus obesus	Chuckwalla		Saxwarʉ	Chah-kwar-rah (k) Sahk-war-rah (s) Tsah wahr (n)	
Sceloporus magister	Yellow-backed Spiny Lizard			Tsahng-ahv (k) Chahng-ahnts (s) Ching-ki-ahng-ah (sj) Tsang-ants (n)	
Sceloporus sp.	Scaly Lizard		Changa'		
--	Lizard	Su-gu´-pits (k) Mu-gwi´ (lv)	Pompotsatsi Moxwia Sʉxʉpʉtsi		

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
			Snakes		
Crotalus atrox	Western Diamondback Rattlesnake				
Crotalus viridis abyssus	Grand Canyon Rattlesnake				
Crotalus sp.	Rattlesnake	To-go´-avw (k) O-lo´-ga (lv)	Toxoavi Tanakitsi	To-go-ahb (k) To-ko-ahv (s) To-ko-ahv (sj) To-go-av-ve (n)	
Lampropeltus getulus	California Kingsnake				
Pituophis melanoleucus	Gopher Snake, Bullsnake		Oxomputsi	Ko-hum-buts (k) Kaw-kum-puts (s)	Oxoputs
--	Snake	Ta-na´-kuts (lv) Kwi´-uts (lv)			
			Amphibians		
Bufo punctatus	Red-spotted Toad				
Bufo sp.	Toad	Wa-gu´-tats (lv)	Pumpun'noa-' Pukwan'a	Pah-kwahn Wah-hot (k) Wah-hawt (s) Pah-kwahn (n)	
Rana pipiens	Northern Leopard Frog				
Rana sp.	Frog		Waaxotsi	Wah-raht (k) Wah-kaht (s) Pah-tim kwahn (sj) Wah-gah-tsets (n)	Waaxots

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
			Birds		
Aeronautes saxatalis	White-throated Swift				
Amphispiza bilineata	Black-throated Sparrow				(NR)
Anas platyrhynchos	Mallard Duck		Oochʉxa	Pe-at choog (k) Choo^{ch} (s)uuchʉxa Choog (n)	Parʉv
Anas sp.	Duck		Chʉxa		Chʉx
Aphelocoma coerulescens	Scrub Jay, California Jay			Cha-inch (k) Cho-wink (sj) Chi-ak (n)	(NR)
Cyanocitta sp.	Crested jay		Oxochayaku	Ah-run Chi-ahk (k) Sik-koo-ra-gwuts (sj) Ho-gon Tsi-ahk (n)	
Gymnorhinus cyanocephala	Pinyon Jay		Aanga	Ahng Uv-ve (k) Ki-vah witch et (s) Ahng-av (sj) Ahng (n)	Tʉvawitsi'ts
Perisoreus canadensis	Canada (Gray) Jay	Ong´-a (k)			
?	Maximillian Jay	O-go´-chi-ok (k)			
?	(Uncrested) Blue Jay		Cho'ingki		
Aquila chrysaetos	Golden Eagle			Kwahn-ants (k) Mung (n)	Kwanants
Haliaeetus leucocephalus	Bald Eagle			Si-kwah (k)	Piakwanants Piasakwanants
--	Eagle	Kwi´-nants (k) Mung-i´-puts (lv)	Kwanants		

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
Archilochus alexandri	Black-chinned Hummingbird				
--	Hummingbird	Mu´-tu-chats (k)	Mootuchats	Mo-te-tcheh (k) Mo-too-tsahts (s) Ah-to-e-tsets (sj) Moo-tin-zits (n)	Mutuchʉts
Athene cunicularia	Burrowing Owl			Ko-gots (k) Pah-kah mo-puts (s) To-cha-et tah-tah-mah-ahs (sj) Ho-koo-gootch (n)	Kohowits
Bubo virginianus	Great Horned Owl	Mo´-puts (k) Mo-o´-puts (lv)´	Moopʉts	Mo-puts (k) Moo-oo-put (s) Mo-o-puts (sj) Moo-e-pwits (n)	Muupʉts
Buteo jamaicensis	Red-tailed Hawk	Kwī-nat´-sits (k)	Kwanantsits	Kwah-nah-tsits (k) Se-kan-na kwahn-ant (s) Ta-ah kwah-nahts (sj) Kwen-nan-zits (n)	Kʉsav
Callipepla gambelii	Gambel's Quail				Akar
Lophortyx sp.	Valley quail		Kakara	Kah-rahm-put (k) Kah-kar-reh (s) Tu-rah-kah-ram-puts (sj)	
Oreortyx pictus	Mountain quail			Too-wit (n)	
--	Quail	Ka´-ka (k) Ka-ka (lv)´			
Campylorhunchus brunneicapillus	Cactus Wren				

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
Salpinctes obsoletus	Rock Wren			Too-ching-ing (n)	Tʉmpikixots
Troglodytes sp.	Wren			Wu-nat tim-be ro-put (k) T'kes-se chim-mits (sj)	
Carpodacus mexicanus	House Finch				
Carpodacus purpureus	Purple Finch			We-etch (k) Waw (s) We-ets (sj) We-we-ets (n)	
Cathartes aura	Turkey Vulture	Whu-gump´-uts (k) Whi-ku´-puts (lv)	Wikumpʉtsi	We-kum-buts (k) We-koo-puts (s) Week (sj) Week (n)	(NR)
Chordeiles acutipennis	Lesser Nighthawk		Mono'opangwits	Pe-utch (k) Too-gow-wit-se (s) Mo-mo-pits (sj) Mum-mo-paht (n)	Tuwawitsi'ts
Colaptes auratus	Flicker	Un-ka-kwo-nau-ants (k)	Angkakwanagwav	Anyka-kwanangwav Un-kah (k) Kwar-nah-kits (s) Kah-kwah-nah-ahts (sj) Kwah-nah-vant (n)	Ungkakwa-nangwav
Corvus corax	Common Raven	A-ta´-puts (k) A-ta´-puts (lv)	Atapʉts Atakots	Tah-kwots (k) Ah-tah-pah-ki'p (s) Tah-kwahts (sj) Ah-tah-pwits (n)	Atapʉts Atakots
Falco peregrinus	Peregrine Falcon				

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
Grus mexicanus	Sand Hill Crane			Cha-kor (k) Kah-uv (s) Cha-kor-rah (n)	
Grus sp.	Crane	Si-kor (k) Tso-ko´-av (k) Tsa-kōr (lv)	Kocha'itoichʉmwʉ (sandhill crane?)		Pahʉrkav Pahʉrkats
Lanius ludovicianus	Loggerhead Shrike			Tah-tso-noint (k) Tah-cho-noint (sj) Tun-dun-nois (n)	
Larus delawarensis	Ring-billed Gull				
Larus sp.	Gull		Tosapayampʉtsi	Che-yu[ch] (sj) Pi-yam'b (n)	(NR)
Meleagris gallopavo	Wild Turkey				Kwiyuwits
Mimus polyglottos	Northern Mockingbird			Yamp (k) Yahmp (s) Yam'p (n)	Yamp
Passerinea cyanea	Indigo Bunting				(NR)
Zenaida macroura	Mourning Dove				Iyov Ayov
--	Dove	Ai´-yuv (k)	Iyovi	Oi-uv (k) Ha-o'v (s) Che-yu'[ch] He-ov (n)	
	Bird	Wi´-chits (k) Wi´-chits (lv)	Witsi'tsi		Witsi'tsi
			Fish		
Catostomus sp.	Sucker, Pipefish		Chungupaxʉ		

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
Cyprinodon carpio	Carp				
Gila cypha	Humpback Chub				
Gila elegans	Bonytail Chub				
Oncorhynchus mykiss	Rainbow Trout				
Pimephales promelas	Fathead Minnow				
Ptychocheilus lucius	Colorado Squawfish				
Rhinichtys osculus	Speckled Dace				
Salvelinus fontinalis	Brook Trout				
Xyrauchen texanus	Razorback Sucker				
--	Trout	Pa´-gu (k)	Anykapaxʉ		
--	Fish	Pa-guts (lv)	Paxʉu		Paxʉts
			Invertebrates		
Lycosa sp.	Tarantula			We-gaht-sawt (k) Oo-gats-shawt (s) Kwahnt (sj) Nu-e-saw-bits (n)	
	Black-widow Spider				
Centruroides exilicauda	Straw-colored Bark Scorpion				
Dasymutilla sp.	Velvet Ant				
Pheidole sp.	Harvester Ant				

Scientific Name*	Common Name	Powell (1873)**	Sapir (1910)	Merriam (1932)***	1995****
--	Ant	Ta´-si-av (k)		Tas-se-av (k) Se-av (s) Too-kwas ha-av (sj) Tas-se-av (n)	
--	Red Ant	Un-kav´-tu-si (k)	Tasuavi	Pas-se-av (k) Ti-av (sj) Tas-se-ev (n)	
--	Big Black Ants		Tuxwatasuavi		
--	Samll Black Ants		Angaavi		
Family Culicidae	Mosquito	Mo-avw (k)	Moo'angiv	Mo-ahv (k) Mo-ahv (s) Mo-o-av (sj) Mo-oo-av-ve (n)	
Family Pentatomidae	Stink Beetle	Ku´-i-tsat (k)	Ukuvichatsi		
Order Dipteria	Fly	Mo´-pits (k)	Moopits Moopichatsi	Mo-pitch-a (k) Mo-pe chats (s) Mo-pits (n)	
Order Scorpionida	Scorpion			Tah-wur-rum-kwe-pitch (k) Kwag-tahnp' (sj) Wah-wah-tsets (n)	
--	Louse			Se-ap-pit (k) Po-ahv (s)	
	Kanab Amber Snail				

* Scientific names taken from Burt (1980) - mammals; Behler and King (1994) - reptiles and amphibians; Brown, Carothers, and Johnson (1987) - birds; Minckley (1991) - fish; Borror and White (1970) - insects; and Emerton (1961) - spiders

**(k)=Kaibab; (lv)=Las Vegas

***(k)=Kaibab; (s)=Shivwits; (sj)=San Juan; (n)=Nevada

****(NR)=Not remembered

organisms. Members of a local community perceive differences among organisms, and in many cases animals cannot be perceptually distinguished at the species and genus level. Atran (1990)argues that the distinction between genus and species within any given local community is frequently unnecessary because only one species of each genus exists within the area. Where distinctions are made among species of the same genus, these is often ecological or geographical variation in their living habits that separate the species.

Several additional observations can be made about this data. There are two terms for mammals that appeared on only two of the lists. These are the Kaibab squirrel and prairie dog. Their presence is not explained by the available data.

Earlier sources, recorded by Powell and Sapir, list fewer birds than the later ones, so interpretation of the bird data must take this into account. Consultants in 1995 named more birds than the earlier sources. The following species were mentioned only twice prior to 1995: mallard duck, lesser nighthawk, pinyon jay, burrowing owl, and mockingbird. Two factors constrain the interpretation of these limited data: (1) earlier sources do not record them, and (2) the Paiute preference for generalization, where burrowing owl is given the name for owl. The second factor cannot explain mockingbird, lesser nighthawk, or pinyon jay.

There is obvious *dialect variation*, differences in word form peculiar to separate localities or groups, in the following terms: wolf, coyote, gray fox, chipmunk, and the specific varieties of eagles. Dialect variation in Paiute seems to be one indication of cultural significance. Of these animals, wolf, coyote, and fox are important in Paiute and Numic mythology. Often there are both an ordinary name and a mythic name for animal actors in myths.

Animals with names for which there is no dialect variation but that have been in use for a long period of time are also culturally significant. Several factors explain the importance of these animals. Some are common in the area, some are important for food or other material cultural needs, and some are perhaps of non-material cultural significance. Table 2.4 shows the mammals, amphibians, and birds included in the sample that, based on these criteria, have been important to Paiutes over a period of about 125 years (1873-1995).

Meaning of Animals in Southern Paiute Culture

The review and analysis of Southern Paiute animal names provides information about culturally significant animals over more than one hundred years. This section provides information about the meaning of animals in Southern Paiute culture during mythic time, traditional time, and current time. Information about animals during mythic time was gathered primarily from published accounts of Southern Paiute stories. This is not intended to be a comprehensive report of all mythic stories that involve these animals; many mythic stories have not been shared with non-Indians and have never been published. Stories were drawn from *Anthropology of the Numa* (Fowler and Fowler 1971), *Why the North Star Stands Still and Other Indian Legends* (Palmer 1978), and *Southern Paiutes* (Martineau 1992). Occasional mention was made of these stories during the individual and group interviews with Southern Paiute organisms. Members of a local community perceive differences among organisms, and in many cases animals cannot be perceptually distinguished at the species and genus level. Atran (1990)argues that the distinction between genus and species within any given local community is frequently unnecessary because only one species of each genus exists within the area. Where distinctions are made among species of the same genus, these is often ecological or geographical variation in their living habits that separate the species.

Several additional observations can be made about this data. There are two terms for mammals that appeared on only two of the lists. These are the Kaibab squirrel and prairie dog. Their presence is not explained by the available data.

Earlier sources, recorded by Powell and Sapir, list fewer birds than the later ones, so interpretation of the bird data must take this into account. Consultants in 1995 named more birds than the earlier sources. The following species were mentioned only twice prior to 1995: mallard duck, lesser nighthawk, pinyon jay, burrowing owl, and mockingbird. Two factors constrain the interpretation of these limited data: (1) earlier sources do not record them, and (2) the Paiute preference for generalization, where burrowing owl is given the name for owl. The second factor cannot explain mockingbird, lesser nighthawk, or pinyon jay.

There is obvious *dialect variation*, differences in word form peculiar to separate localities or groups, in the following terms: wolf, coyote, gray fox, chipmunk, and the specific varieties of eagles. Dialect variation in Paiute seems to be one indication of cultural significance. Of these animals, wolf, coyote, and fox are important in Paiute and Numic mythology. Often there are both an ordinary name and a mythic name for animal actors in myths.

Animals with names for which there is no dialect variation but that have been in use for a long period of time are also culturally significant. Several factors explain the importance of these animals. Some are common in the area, some are important for food or other material cultural needs, and some are perhaps of non-material cultural significance. Table 2.4 shows the mammals, amphibians, and birds included in the sample that, based on these criteria, have been important to Paiutes over a period of about 125 years (1873-1995).

Meaning of Animals in Southern Paiute Culture

The review and analysis of Southern Paiute animal names provides information about culturally significant animals over more than one hundred years. This section provides information about the meaning of animals in Southern Paiute culture during mythic time, traditional time, and current time. Information about animals during mythic time was gathered primarily from published accounts of Southern Paiute stories. This is not intended to be a comprehensive report of all mythic stories that involve these animals; many mythic stories have not been shared with non-Indians and have never been published. Stories were drawn from *Anthropology of the Numa* (Fowler and Fowler 1971), *Why the North Star Stands Still and Other Indian Legends* (Palmer 1978), and *Southern Paiutes* (Martineau 1992). Occasional mention was made of these stories during the individual and group interviews with Southern Paiute

Table 2.4. Culturally Significant Animals by Category

Animal Categories				
Mammals				
Predators	*Smaller Carnivores/ Omnivores*	*Large Game Animals*	*Small Game Animals*	*Other*
*wolf	skunk	antelope	squirrel	beaver
*coyote	badger	bighorn sheep	*chipmunk	bat
mountain lion	*gray fox	deer	wood rat	
bobcat/wildcat	porcupine		cottontail	
			jack rabbit	
			mouse	
Amphibians/Reptiles				
frog/toad				
Birds				
Raptors and Predators	*Songbirds*	*Game Birds*	*Water Birds*	
raven	hummingbird	dove	sandhill crane	
great horned owl	flicker	quail		
*eagle		duck		

*Dialect variation

consultants. As noted, Paiute people tend not to share mythic time information with non-Indians. Also, even when they wish to share such information, they should do so when the snow is on the ground in the winter, and the *Colorado River Corridor* study trip occurred in April. The following illustrates the dilemma faced by consultants during the study.

> There's a story about the cottontail, but it's the summer and I'm not supposed to tell you... [long pause] ... Let's go find somebody else.

During the April 1995 study, Southern Paiute consultants shared information about the traditional and contemporary meaning, importance, and use of animals. Sixty-nine individual interviews regarding 28 animals were completed during the study. The interview notebooks were useful for providing (1) a stimulus for the consultants to remind them of various animal parts and their uses, and (2) a means by which the consultants could ensure that the ethnographers understood which part of the animal was being discussed. For example, one individual remembered that she used the leg bones of the deer in stew when running her hand over the picture of the deer. Another consultant, when completing an individual interview about the mountain lion, used the picture to demonstrate how to cut off the animal's fur. Information from published accounts of Southern Paiute culture was used to supplement the discussion of traditional meaning, use, and importance. Published documents are included in this section to provide a context and possible evidence of change in the meaning of particular animals in Southern Paiute culture. No effort has been made to record every mention of Southern Paiute use of animals. Instead, most of the information has been taken from two summary reports: Euler's (1966) *Southern Paiute Ethnohistory*, and Fowler and Matley's (1979) *Material Culture of the Numa*.

This section is organized by animal class: (1) mammals, (2) reptiles, (3) amphibians, (4) birds, and (5) fish. Within each class, animals are listed alphabetically by scientific name. Each animal description includes (1) a brief discussion of the animal's meaning during mythic time, (2) a brief summary of interview data regarding the animal's traditional and contemporary uses, the animal parts used for these various purposes, and preparation techniques, and (3) a brief summary of uses recorded in published accounts. Only animals from the Ethnofaunal Study List that were discussed by the consultants in either individual or group interviews are included here. The data clearly indicate that animals continue to be highly important cultural resources to Southern Paiute people.

Mammals

Antilocapra americana - Pronghorn Antelope

Southern Paiute consultants know of mythic stories that involve the antelope. Some of those stories are reported in Fowler and Fowler (1971:81) and Palmer (1978:52). The antelope has at least two mythic names.

Two Southern Paiute consultants completed individual interviews about the antelope. Antelope were traditionally and continue to be used for food, ceremony, clothing, tools, and other purposes. As one respondent said, "The Old People say antelope are God's blessing." Antelope are hunted in the fall for their meat, but the blood, internal organs, and brain are eaten as well. Antelope meat is prepared by broiling the entire animal over charcoal. In addition, the meat can be ground, boiled, fried, roasted, and dried. The blood is eaten raw or dried. One consultant noted that some people use the blood when making hot dogs and commented, "It is good for kids. It teaches them to be hunters."

Antelope horns are used in ceremonies and also as trophies. Clothing is made from the hide and sinew of the animal. The hide is dried and tanned for moccasins and leggings. The sinew is cut out from the back of the animal and soaked, stretched, and dried to be used for thread. Antelope bones are fed to dogs and also used to make musical instruments for children. Teeth are used as beads on necklaces. Tools are made by cutting up antler horns and preparing and drying sinew, as described above. Finally, the brains of the antelope are used when tanning buckskin to make it soft.

Southern Paiute use of antelope for food has been well documented (Euler 1966:112). In addition, clothing was made from antelope skin (Euler 1966:114; Fowler and Matley 1979:9), jewelry was made from the jawbone (Fowler and Matley 1979:57), and arrow straighteners were made from the horns (Sapir 1910: 80-83).

Canis latrans - Coyote

Southern Paiute consultants know stories and legends about the coyote. The coyote is an important figure in Southern Paiute mythology. Numerous stories and legends describe the mythic coyote (Fowler and Fowler 1971:220, 221; Palmer 1978:11, 35; Martineau 1992:2, 10, 11, 13, 22, 25, 26, 31, 33, 37, 37, 38, 41, 45, 74, 75, 103). These include the Paiute creation story and stories explaining phenomena such as seasons of the year and the origin of menstruation. Coyote is also a central figure in many stories that describe the relationships among animals and has many mythic names.

Figure 2.1. Coyote tracks in sand on the beach at National Canyon

Three consultants completed individual interviews on the coyote. Two of these individuals said that the coyote would never be captured; it comes when it has a message. The third individual said the coyote was trapped early in the morning before the sun comes up. Coyote skins were removed and dried to be sold for cash income. The tail was used to add color to clothing. One consultant commented that her people never used the coyote, but members of other tribes have and continue to use the coyote's skin to make costumes for dancing.

Canis lupus - Wolf

The wolf is an important figure in Southern Paiute mythology. He is the elder brother of the coyote and has several mythic names. Fowler and Fowler (1971:86, 221) and Martineau (1992:2, 18) each relate two mythic stories involving the wolf.

> Toovuts was the righteous one who wanted peace, love and people to live forever.
> Martineau (1992:2)

No individual interviews were conducted on the wolf during the 1995 study. Powell (1895:104-106) observed Southern Paiute men wearing wolfskin robes.

Castor candensis - Beaver

Paiute consultants know of stories involving the beaver. In one story, the beaver lost the hair on its tail because he was too proud (Palmer 1978:37).

One consultant completed an individual interview on the beaver. The beaver pelt was traditionally used for clothing. Fowler and Matley (1979:67) describe arrowcases made from beaver hide. The hide had been tanned with the fur on, and the fur was left on the outside of the case.

Citellus sp. - Squirrel

No individual interviews were conducted on squirrels during the 1995 study. Powell (1895:104-106) records the use of squirrel tails to decorate festival clothing. Fowler and Matley (1979:76) describe a pouch made out of a tanned squirrel skin.

Cynomys gunnisoni - Prairie Dog

Southern Paiute consultants know stories involving prairie dogs. No published stories were found during this study.

Six consultants completed individual interviews about prairie dogs. Prairie dogs were traditionally and still are hunted and trapped in the spring and summer for food, clothing, and other purposes. The most common method of capturing prairie dogs is to pour water down the animal's hole, cover the hole until the prairie dog comes up, and then either grab the prairie dog or hit it on the head with a club. Southern Paiute use of the prairie dog has been limited due to hunting restrictions and development on lands traditionally used for hunting.

Prairie dog meat was traditionally roasted underground, but it is more commonly roasted in an oven or boiled today. The prairie dog is first placed over coals (or a stove) until the hair is burned off. Then the animal is cut open, the internal organs removed, and the inside cleaned. It is sewn shut or tied together with a stick and cooked early in the morning to be ready to eat by afternoon. The prairie dog is cooked by being placed on top of coals and covered, and then a fire is built over it (or it is placed into a plastic bag in the oven or into a pot of boiling water). The fat of the animal is used in cooking.

The hide and fur of the prairie dog are used for clothing. The hide is cut at the ankle, sometimes including a little bone to make it easier to attach to buckskin. The hide is let dry and worked with a rock until it is soft. The fur is then washed and combed. It is then attached to buckskin clothing or placed on the end of a stick for use in powwows. The bones are cut with flint to make beads, and the teeth are used on necklaces. The bones are also ground into a fine powder for use as paint. The skull and bones are used in a game.

Erethizon - Porcupine

Southern Paiute consultants know of mythic stories involving the porcupine. These are reported by Fowler and Fowler (1971:86), Palmer (1978:56), and Martineau (1992:33).

Two individual interviews were conducted on porcupines. Porcupine were traditionally and occasionally still are used for food. The animal is cut open and its internal organs removed. Then it is put on coals in a pit underground and roasted. The hair, bones, quills, claws, and teeth of the porcupine are used on clothing. The hide is removed, washed, and dried. The quills are strung together and put on a stick for use in dancing. The teeth are strung on necklaces.

Southern Paiute use of porcupines for food has been recorded (Euler 1966:113; Gregory 1948:139; Kelly 1964:52). Fowler and Matley (1979:58) also describe necklaces made of porcupine quills.

Eutamis sp.

The chipmunk is a central figure in a mythic story about quarreling (Fowler and Fowler 1971:95). No individual interviews were conducted on chipmunks during the 1995 study. Fowler and Matley (1979:9, 58) noted that chipmunk tails were used to decorate festive clothing and were attached to necklaces.

Felis concolor - Mountain Lion

Southern Paiute consultants know of stories involving mountain lions. No published stories were found during this study.

One consultant completed an individual interview about the mountain lion. The mountain lion was traditionally and continues to be used in ceremonies, for clothing, and for tools. The fur and claws are specially prepared for use in ceremonies. The hide, claws, teeth, and tail are used for clothing. The hide is scraped with a rock and may be coated with the animal's brains to make it stay soft. The brains are fried and then combined with a bit of water. They are spread on the hide, worked in with the hands, and let dry. Eggs are sometimes used in place of brains; they are beaten, fried, and combined with water prior to use. The claws of the mountain lion are used on bracelets, teeth are used on necklaces, and tail is used as a hair piece or ornament to hang on a dance outfit. The fur covering the tail is pulled off in one piece, left inside out and cleaned, let dry, and prepared in the same way as the hide. The tail is worn with the fur side out. Mountain lion bones are used as tools. Fowler and Matley (1979:67) describe the use of mountain lion skin to make arrowcases.

Lepus californicus - Black-tailed Jack Rabbit

Southern Paiute consultants know mythic time stories involving the jack rabbit. For example, the jack rabbit is involved in the story of how the seasons were set (Palmer 1978:66; see also Cottontail).

Seven individual interviews were completed on the jack rabbit. The rabbit was traditionally and continues to be a very important animal resource for Southern Paiute people. According to one consultant, "We used everything on the rabbit." Uses for the rabbit include food, ceremony, clothing, tools, and other purposes. The rabbit was traditionally hunted, year round, with a rabbit club; a group of individuals would chase the rabbit toward one man who would then club it to death. Later, Paiutes would chase and club rabbits from horseback. Today, rabbits are hunted with shotguns.

The meat, bones, blood, fat, and internal organs of the rabbit are used as food. The meat is boiled, fried, roasted in the ground or oven, and dried. According to one respondent, her grandmother would attach a greasewood (*Larrea tridentata*) stick to the rabbit skull, wrap the rabbit around the stick, and put the entire animal in charcoal. According to another consultant, prior to roasting the animal is cut open, the internal organs are removed, and the cavity is salted. The meat is dried in strips. In former times, Paiutes ate the rabbit's intestines, heart, liver, kidneys, and brains; one individual said his family still eats the brains. The fat can be specially prepared for cooking; it is cut into strips, soaked in water, and then used.

Special rabbit fur garments are worn in ceremonies. The fur is used for making blankets and clothing. The rabbit fur is wrapped in a clean cloth and hung outside to dry. Strips approximately two inches wide are cut and woven together to make a blanket. As one consultant said, "It is the warmest thing there is .. tie up 24 pelts with sinew [to make a rabbit blanket]." Articles of clothing made from rabbit fur include caps and hats, foot pieces to place inside the shoes, and jackets. On one type of cap, the rabbit's feet are left to hang over the wearer's ears. The tail is used in a hat or left on the skin when the blanket is woven. Rabbit bones are used to make beads for necklaces and are also used to make whistles. Bones and sinew are used as tools; eating utensils similar to forks are made from rabbit bones. Also, rabbit skulls are used in Paiute games and as children's toys.

Extensive documentation exists of Southern Paiute use of rabbits as food (Euler 1966:112) and for making robes and blankets (Euler 1966:114-115).

Lynx sp. - Bobcat/Wildcat

The bobcat is featured in Paiute mythic stories (Fowler and Fowler 1971:87; Martineau 1992:26).

No individual interviews were conducted on the bobcat during the 1995 study. Dellenbaugh (1908:256) and Jones (Gregory 1948:170) observed Uinkaret Paiutes who worked for John Powell's expedition skinning and boiling the meat of a bobcat for food. Kelly (1964:53, 76) reported that bobcat flesh was roasted overnight in an earth oven; it was never placed directly on coals. She also described use of the hide for caps and arrow quivers. Powell (1895:104-106) observed Southern Paiute men wearing bobcat skin robes. The Paiutes also used the skin for mats or blankets (Darrah 1947:69), as cradleboard swaddling (Fowler and Matley 1979:61), and for making arrowcases (Fowler and Matley 1979:67).

Neotoma sp. - Woodrat/Mountain Rat

Two mythic stories featuring the mountain rat have been recorded (Fowler and Fowler 1971:87; Palmer 1978:89). No individual interviews were conducted on the mountain rat during the 1995 study.

Odocoileus hemionus - Mule Deer

Southern Paiute consultants know stories about deer. Both stories and songs have been recorded in published documents (Fowler and Fowler 1971:123; Palmer 1978:52).

Nine Southern Paiute consultants completed individual interviews on the mule deer. The mule deer traditionally was and continues to be a very important animal resource for Southern Paiute people. Information about what is used, how it is used, and when and why it is used is widely known among the consultants. Some information is known only by men and not shared with women, and it is not included in this discussion. Deer were hunted with bow and arrow, primarily in the fall. They were also trapped in a specially built deer corral. Does were sometimes hunted in the summer. Deer are now hunted with shotguns.

The deer is used for food, medicine, ceremony, clothing, tools, and other purposes. As one individual said, "We use the *whole* deer." Southern Paiutes eat deer meat, bones, fat, internal organs, tongue, and brain. The meat is ground, boiled, fried, roasted and dried. Some of the meat is reserved only for men to eat. A woman cannot eat deer meat during menstruation

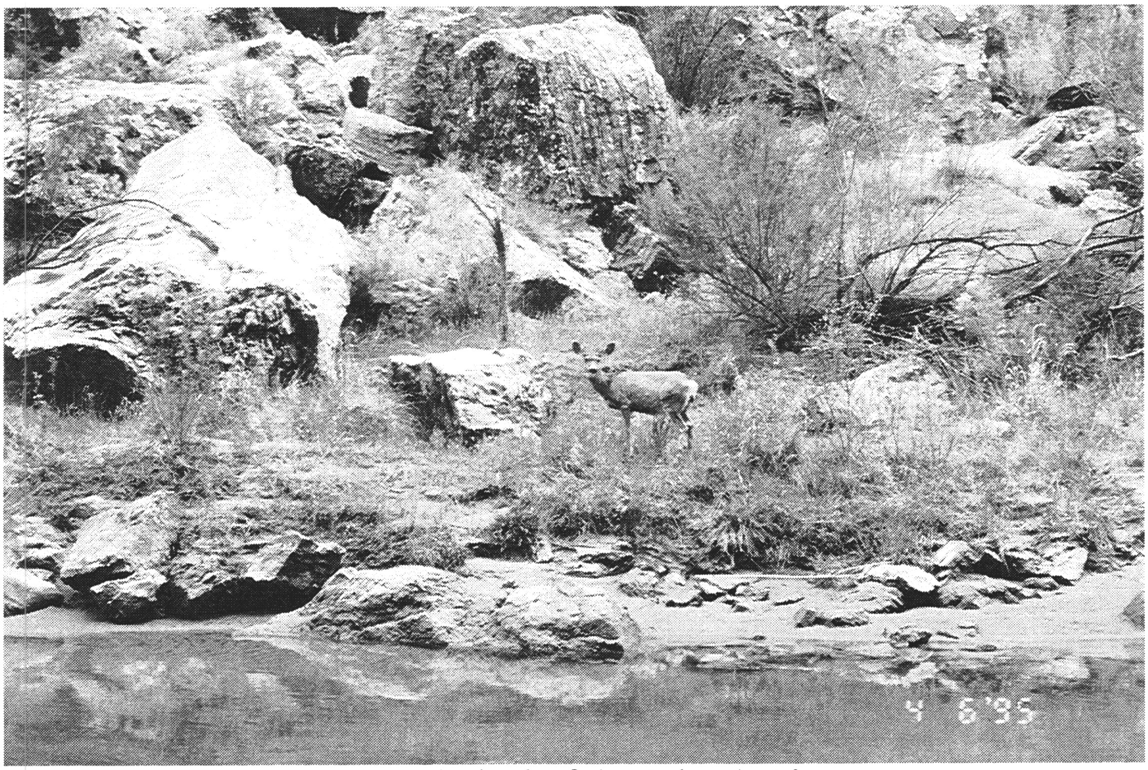


Figure 2.2. A mule deer along the bank of the Colorado River

nor can she touch the bows and arrows, or more recently the guns, that are used in the deer hunt. Neither the father nor mother of a newborn child can eat deer meat. The large bones of the deer are broken and the marrow eaten. The leg bones are cut across the knee and used in stews. The fat is used as lard in cooking. The internal organs are fried or roasted and eaten only by men and by women after menopause. The tongue and brain are eaten as well.

Deer meat is boiled to create a broth that is used as medicine. Deer teeth are also used in medicine bags. Fresh blood is drunk by young men to make them good hunters. The meat, hide, bones, feet, tail, antlers, and internal organs are used in ceremonies. The hide, teeth, tail, antlers, and sinew are used to make clothing. The hide is prepared by soaking for three or more days, scraping off the hair beginning with the inside, rubbing it with brains and blood, and drying. The hide is used for jackets, vests, moccasins, gloves, pants, cradleboard lining, ornaments, and blankets. The leg bones are used for making beads, and these and the teeth are used on necklaces. The toenails are used on men's shoes. The tail is sometimes left on the hide to be used for decoration. A beaded tail is placed on a stick for use in powwow dancing. A section of the antlers can be cut out for use on a belt; antlers are also used to make buttons, necklaces, and ornaments. Sinew is taken from the back of the deer for use as thread. It is hung up and dried until it can be pulled apart in strings. The thread is used for sewing moccasins and other clothing.

Many parts of the deer are used for making tools. The bones are used to make awls for sewing and weaving baskets, and the rib bones are used to scrape the fur off hides. The antlers are used to move rocks during sweat lodge ceremonies. Deer fat is used to grease and waterproof shoes, harnesses, and saddles. It is used with pine gum to attach feathers to arrows. Sinew is used to tie flint and feathers to arrows and on the end of a rope to secure it to another object. The deer bones and antlers are also used for making handgame pieces, the bones are made into noisemakers, and the feet are made into rattles. Deer hide is used to make drum covers.

Extensive documentation has been made of the traditional importance of deer in Southern Paiute culture. Deer was an important food source (Euler 1966:113). Men's clothing included breechcloths, moccasins, leggings, and shirts made of buckskin (Fowler and Matley 1979:28), and women wore buckskin skirts (Bolton 1950: 201) and doeskin shirts (Euler 1966:115). Fowler and Matley (1979:53, 60) describe the use of buckskin pieces and sinew stitching for a headdress, cradleboard, and bowcase. They also describe the use of buckskin and woven cloth for cruppers, devices used with horse saddles (Fowler and Matley 1979:82). Deer sinew was also used to make bows, bow string, and arrows (Sapir 1910:84; Fowler and Matley 1979:63, 64). The deer antlers were carved into tapered flakers for making arrows (Fowler and Matley 1979:66) and used to make glue for laying sinew backing on bows (Kelly 1964:73).

Ovis canadensis - Desert Bighorn Sheep

Southern Paiute consultants know mythic stories and songs about the bighorn sheep. Some of the stories tell about the sheep in the Grand Canyon; Paiutes came into the canyon to see the sheep during the migratory season. In the mountain sheep dance, a ceremony that takes place prior to a hunt, the bighorn sheep has its own song. Fowler and Fowler (1971:223) and Palmer (1978:72) relate stories involving the mountain sheep. References to the mountain sheep songs and dance are also common (Fowler and Fowler 1971:123; Palmer 1978:30; Martineau 1992:101).

Six consultants completed individual interviews on the bighorn sheep. The bighorn sheep is another animal that traditionally was and continues to be very significant in Southern Paiute culture. Its uses include food, medicine, ceremony, clothing, tools, and other purposes. However, hunting is severely restricted. The animal was generally hunted in the fall, and the meat, fat, and internal organs are used for food. The meat is boiled, fried, roasted, and dried. One method of preparing the meat is to place it in the bowel bag and then bury it for roasting. The fat is also eaten. One individual believed the horns were used to make medicine. The hide and horns were used in ceremonies; the horn were used for hats in the mountain sheep ceremony. The hide, bones, feet, and tail are used to make clothing. Traditionally, the sheep's hide was an important trade item because it was not readily available to members of other tribes.

Mountain sheep bones were also made into beads, and the teeth and hooves were used as ornaments on necklaces. The sheep's bones and horns were used for making tools; the foreleg was used to make a scraper for preparing hides, and the horns were made into a variety of tools,

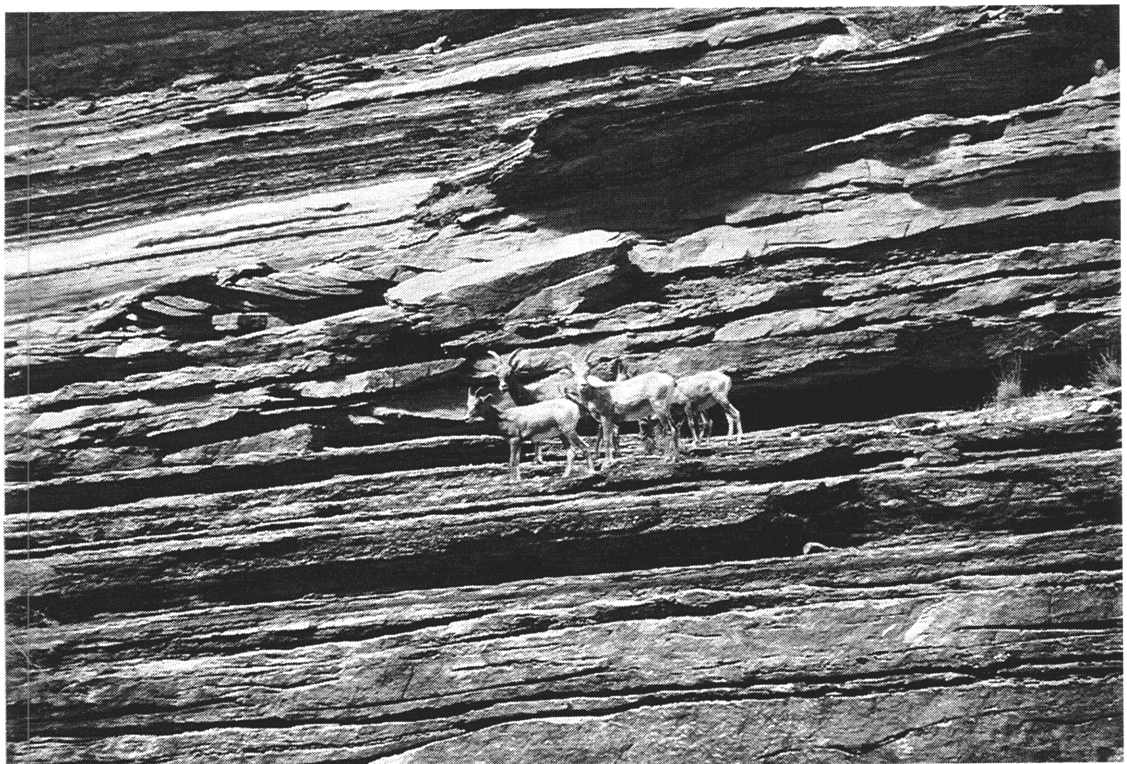


Figure 2.3. Bighorn sheep along the bank of the Colorado River

including eating utensils. The sinew was also used for making tools. It was used to attach feathers to arrows. The sinew from the backbone, which is very strong and stretches easily, was used to string bows when the sinew from the deer was not available. The fat was put on the body as a lotion.

Southern Paiute use of mountain sheep has been well documented. The animal was used for food (Bolton 1950:211-212, Powell 1895:316-320; see Euler 1966:112-13), and mountain sheep were used to make skirts (Euler 1966:115). The horns were used to make bows (Fowler and Matley 1979:62-63, Euler 1966:114), arrow straighteners (Fowler and Matley 1979:65, Euler 1966:115) and spoons and dippers (Fowler and Matley 1979:76).

Pipistrellus hesperus - Western Pipistrelle (bat)

The Western Pipistrelle was the stimulus for discussion about bats. Southern Paiute consultants know of mythic stories involving the bat. Palmer (1978:41) records one such story.

One consultant completed an individual interview on the bat. The entire bat was used for medicine in the past.

Sylvilagus audubonii - Desert Cottontail

Southern Paiute consultants know mythic stories involving the cottontail. The cottontail attempted to kill the sun by shooting an arrow at it. A stream of fire was emitted from the sun through the wound and burned the earth. The cottontail ran ahead of the fire to warn others and was offered protection by the rabbitbrush (*Chrysothamnus nauseosus*); thus, the bush received its name. In addition, the cottontail has brown spots on the back of its neck because it was burned by the sun (Palmer 1978:25-29). Note that variations of this story involve the jack rabbit instead of the cottontail.

One consultant did an individual interview on the desert cottontail. The cottontail was traditionally and still is used for food, clothing, and other purposes. The cottontail is hunted and pulled from its burrow in the wintertime. A 7-10 foot stick is put into the rabbit's hole, twisted until it grabs the rabbit's fur, and pulled out. The meat, fat, and internal organs are eaten. The meat is ground, boiled, fried, roasted, and dried. The fat is stretched, soaked in water, and then used for cooking. The liver, heart, and kidneys are eaten. The cottontail's fur is used to make clothing. Gloves are made by tanning the inside of the hide and then turning them inside out so the fur is worn against the skin and the tanned side faces out. The bones are used to make needles and awls for sewing and making baskets. The bones are also used to make beads. The teeth are used as jewelry. The sinew (*tamu*) is dried and used for sewing. The skull is used to play a Paiute counting game.

Taxidea taxus - Badger

The badger is featured in several mythic stories (Fowler and Fowler 1971:220; Palmer 1978:101, 103). No individual interviews were conducted on the badger during the 1995 study.

Kelly (1964:52) reported that badgers were not specifically hunted, but when found they would be killed. Badger meat was boiled three times to remove the strong taste, and the hide was used to make moccasin soles.

Urocyon cinereoargentatus - Gray Fox

The gray fox is featured in a mythic story (Fowler and Fowler 1971:87). No individual interviews were conducted on gray fox during the 1995 study.

Mouse

Southern Paiute consultants did not tell of mythic stories involving mice. No published stories were found during this study.

One consultant completed an individual interview about a mouse. Mice were not traditionally captured, but they have been recognized for their role in nature. The consultant told of how her grandfather used to instruct them always to leave some of the crops in the fields for the mice to eat.

Skunk

The skunk is featured in several mythic stories (Fowler and Fowler 1971:95; Palmer 1978:101; Martineau 1992:41). No individual interviews were conducted on the skunk during the 1995 study.

Kelly (1964:54-55) reported that skunks were not eaten, but they were hunted and their pelts sometimes were used to make moccasin soles.

Reptiles

Pituophus melanoleucus - Gopher Snake, Bullsnake

Southern Paiute consultants know of mythic stories about snakes. One such story involves a "hot sand snake" and tells why Paiutes dance the snake dance (Palmer 1978:76).

One consultant completed an individual interview on the gopher snake. The gopher snake was and continues to be used by Southern Paiutes for food and clothing. The snake is gathered in the fall, and the meat is roasted and then eaten. The snakeskin is used to decorate headbands and other articles of clothing. The bones are also used as ornaments.

Published accounts discuss Paiute use of snakes as food (Euler 1966:113). They also describe the use of snakeskin to make ornaments for decorating festival clothing (Powell 1895:104-106) and for necklaces (Fowler and Matley 1979:58).

Sauromalus obesus - Chuckwalla

Southern Paiute consultants know of stories about chuckwallas. No published mythic stories about the chuckwalla were found during this study.

One consultant completed an individual interview on the chuckwalla. The chuckwalla was used by Southern Paiutes as a source of food in the past. The meat was fried and then eaten.

Lizard

According to Southern Paiute consultants, general mention is made of lizards in mythic stories. No published stories were found during this study.

Figure 2.4. A chuckwalla crouches between two rocks to study the photographer

One consultant completed an individual interview on lizards. In addition, several individuals described the medicinal use of lizards during a group interview. Lizards were traditionally used by Paiutes for food and medicine. The lizard was hunted during the winter when food supplies were low, and its meat was roasted and then eaten. One consultant's grandmother used to gather lizards in the summer near her home. The lizard's tail was used to remove cataracts from the eyes. It was split in half and then swept across the eye beneath the lid to remove the cataract. Consultants told about individuals they know who had successfully used this technique.

Amphibians

Rana pipiens - Leopard Frog

Southern Paiute consultants know of mythic stories about the frog. The frog is a central figure in a story about the moon (Fowler and Fowler 1971:221).

One consultant completed an individual interview on the leopard frog. The frog is presently used by Southern Paiutes for food. The frog is caught with a net, and its meat is either boiled or roasted. It is considered "too slimy" for frying or drying. Whipple (U.S. House of Representatives 1856) reported Paiute people eating frogs along the Moapa (Muddy) River.

Birds

Birds have a special place in Southern Paiute culture. For example, bird songs are sung all night before a funeral to help the departed person's spirit travel to the next world.

Anas boschas - Mallard Duck

Southern Paiute consultants did not know of any mythic stories involving the mallard duck. Martineau (1992:31-33) recorded one story about coyote and "Old Man Duck," the medicine man.

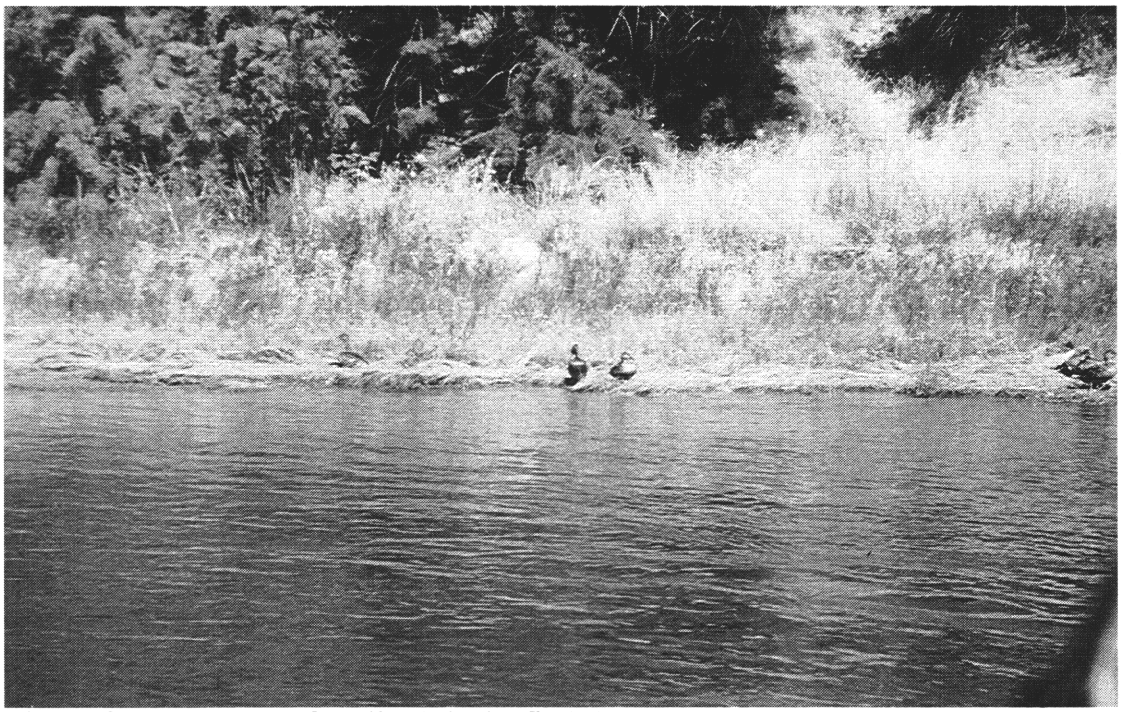


Figure 2.5. A group of mallard ducks find the water they need along the banks of the Colorado River

Two consultants completed individual interviews about mallard ducks. These ducks were traditionally and continue to be used for food, clothing, and making tools. They could be hunted any time during the year, but they were not disturbed while nesting. Duck meat is boiled, fried, and roasted. The fat is cooked with the meat. In the past, duck eggs were eaten whenever they were available. Bones are used to make beads for use on clothing, and feathers are used to decorate headbands or hats. In addition, the bones, feathers, and feet are used to make tools. The feathers are used on arrow shafts. Kelly (1964:54) reported men hunting ducks for food.

Archilochus alexandri - Black-chinned Hummingbird

Southern Paiute consultants know of mythic stories involving the hummingbird, including stories that specifically refer to the Grand Canyon. The hummingbird is a central figure in several mythic stories and has at least three mythic names. For example, the earth was created by the gods with the help of the hummingbird (Palmer 1978:3). In another story, the hummingbird used its cane to create water springs (Martineau 1992:17).

One consultant completed an individual interview about the hummingbird. She has tried to bring hummingbirds near her house and camp by putting out food for them. The hummingbird is recognized for its importance in pollinating flowers.

Bubo virginianus - Great Horned Owl

Southern Paiute consultants know mythic stories about the owl. Palmer (1978:49, 66) and Martineau (1992:41) record stories in which the owl is a central figure.

Two consultants completed individual interviews about the great horned owl. The great horned owl is a special messenger to Southern Paiute people. The owl is not captured; it comes near when it has sad news to relay. Although its activities are never to be interrupted, its feathers could be collected and used on prayer sticks. Fowler and Matley (1979:53) describe the use of owl feathers on a headdress.

Buteo jamaicensis - Red-tailed Hawk

Southern Paiute consultants know mythic stories involving the red-tailed hawk. Some of the stories include the Grand Canyon because this animal breeds in and migrates through the canyon. Martineau (1992:45) recorded a story involving hawks.

Two individual interviews were completed on the red-tailed hawk. The hawk was and continues to be trapped or hunted for medicine, ceremony, clothing, and tools. The bones and feathers are used medicinally. Fans made of hawk feathers have special power. The bones and feathers are also used in ceremonies. One consultant told of the use of hawk feathers at Sun Dances held in Cedar City, Utah during the early 1900s. The feathers are used to make fans that are used for smoking people and things to ward off evil. Under certain conditions when feathers are removed from live hawks and the hawks released, the hawk and person will have a special relationship. As one individual said, "Then let it go. Then you will know someone will be there to look after you." Hawk feathers and claws are used for decoration. The feathers are attached to buckskin and other articles of clothing, and the claws are worn on a necklace.

During one interview, a consultant was reminded that bird hearts were used as love charms. Though she was not certain if the hawk's heart was used, it is reported here because it was her discussion of the hawk that triggered this memory. She warned that one had to be cautious using the love charm because it can backfire and cause harm to one's relatives.

Published documents report the use of red-tailed hawk feathers on headdresses (Fowler and Matley 1979:53) and arrows, primarily those used for hunting small game (Sapir 1910:83).

Callipepla gambelii - Gambel's Quail

Southern Paiute consultants know of mythic stories about the quail, including stories that involve the Grand Canyon. Martineau (1992:102) recorded information about the Paiute Quail Dance.

One consultant completed an individual interview on the Gambel's quail. The quail was traditionally and continues to be used by Southern Paiutes for food, ceremony, clothing, and tools. Quail meat is boiled, fried, and roasted. The feathers are plucked and used in ceremonies, on clothing, and on arrows. Kelly (1964:54) reported Paiutes eating quail eggs. Fowler and Matley (1979:55, 58) describe the use of Gambel's quail topknots and attached scalp feathers in hair ornaments, and bills and scalp pieces on a necklace.

Cathartes aura - Turkey Vulture

Fowler and Fowler (1971:126) tell of a song about the turkey vulture. Southern Paiute consultants discussed the vulture in the group interview but could not remember its Paiute name. No individual interviews were conducted on this animal during the 1995 study.

Colaptes sp. - Flicker

Southern Paiute consultants knew of stories about the flicker. No published mythic stories about the flicker were found during this study.

One consultant completed an individual interview on the flicker, and additional information was gathered during a group interview. The flicker was and continues to be hunted with a slingshot in the summertime when it travels across the Colorado Plateau. Its tail feathers are used to make ceremonial fans. Kelly (1964:53) reported Paiutes eating a red-shafted flicker.

Corvus corax - Common Raven

Mountain sprites (Kai-ni-suva) can take the form of ravens and come to visit Paiute people in their camps (Fowler and Fowler 1971:75). Therefore, when a raven comes into camp and perches on a rock, Paiutes offer it food. No individual interviews were conducted about ravens during the 1995 study.

Gymnorhinus cyanocephalus - Pinyon Jay

The pinyon jay is included in a Paiute circle dance song (Martineau 1992:94). No individual interviews were conducted on the pinyon jay during the 1995 study. Kelly (1964:53) reported Paiutes eating a blue bird without a crest that nests in junipers, probably a pinyon jay.

Haliaeetus leucocephalus - Bald Eagle

Southern Paiute consultants know stories and songs about the eagle, including songs referring specifically to the Grand Canyon and the canyon rim. The eagle is a central figure in many mythic stories (Fowler and Fowler 1971:223; Palmer 1978:14, 45, 46-50, 84; Martineau 1992:37) and is also included in Paiute songs (Fowler and Fowler 1971:122; Martineau 1992:94).

Six consultants completed individual interviews about the bald eagle. The bald eagle has traditionally been and continues to be very important in Southern Paiute culture. Eagles are used for medicine, in ceremonies, in making clothing, and for other purposes. The eagle's bones are used as medicine, the leg bones are used for making the special whistles used in dances and for making beads, and the skull is beaded and used on a stick in ceremonial dances. Eagle feathers are plucked, washed, and dried with salt before they are used. Often they are beaded and sewn, one-by-one, onto buckskin. The feathers are used on a staff during ceremonies and dances, on the costume of the eagle and traditional dancers, and on prayer sticks. Sometimes the entire wing of the eagle is used. Eagle feathers represent power and strength. The talons of the eagle are also used for medicine, in ceremonies, on clothing, and for other purposes. The talons are sometimes beaded and attached to a stick for use in a ceremonial dance. They are also used to ward away ghosts. The eagle's head is mounted on a stick to be used by veterans in ceremonial dances and at powwows.

The golden eagle (*Aquila chrysaetos*) is used and treated in the same way as the bald eagle. Published accounts record the use of eagle feathers for headdresses (Fowler and Matley 1979:53) and on arrows used in big game hunting (Sapir 1910:80-83). Kelly (1964:92-93) reports that eagle nests (aeries) were owned and passed from father to son. These aeries were a key source of feathers which were both necessary for producing arrows as well as for ceremonies. Eagle feathers were a trade item; a bundle 2 to 3 inches in diameter brought a buckskin in exchange.

Meleagris gallopavo - Wild Turkey

Southern Paiute consultants did not know of any mythic stories involving the wild turkey. No published mythic stories about wild turkey were found during this study.

One individual interview was completed on the wild turkey. The turkey was and continues to be used for food. The turkey was traditionally hunted with a bow and arrow and later with a shotgun. The meat, fat, and internal organs are boiled or roasted before they are eaten. The consultant told how her mother used to prepare the turkey for cooking by placing it in very hot water so the skin, with the feathers still attached, comes off quickly. All parts, including the neck and internal organs, were eaten.

Salpinctes sp. - Rock Wren

Southern Paiute consultants know of stories involving the rock wren, including stories about the wren in the Grand Canyon. No published mythic stories about the rock wren were found during this study.

One consultant completed an individual interview on the rock wren. The wren was recognized by its song. Wrens were not captured; their feathers were and continue to be used in ceremonies. When dead, the wren's body is buried underground as a gift "back to Mother Nature."

Zenaida macroura - Mourning Dove

Southern Paiute consultants know of stories about the mourning dove. No published mythic stories about the mourning dove were found during this study.

Three consultants completed individual interviews on the mourning dove. Doves were and continue to be hunted for food, ceremony, clothing, and tools. Doves were traditionally hunted with a slingshot or bow and arrow or were beaten with a stick. Today they are hunted with guns. The meat of the dove is ground, boiled, fried, roasted, dried, and baked. The feathers, wings, and heads are kept for sacred ceremonies. The feathers are used by medicine men, and the skull is used as an ornament on ceremonial necklaces. The entire bird can also be dried in a specified position to be used in ceremonies. Dove feathers are also plucked and used to decorate buckskin and other articles of clothing. The bones are cut with flint and used as tools. Kelly (1964:53) reports that doves were hunted from blinds built near watering places. When killed, they were plucked, cleaned, and cooked in ashes.

Fish

Trout

Southern Paiute consultants know mythic stories about trout. In one story, the trout was responsible for carrying fire across the river. The fire burned him and produced the red spot on his gills. One consultant noted that the story did not say which river the trout was crossing, but that it could be the Colorado River because that is the source of most of the legendary stories. Fowler and Fowler (1971:125) discuss a Paiute song about trout.

Four individual interviews were completed on trout. In these interviews, the consultants did not differentiate between trout species. The trout were and continue to be used for food. The meat, skin, bones, tail, and fat of the fish are eaten. Trout are fried, roasted over charcoal, or cooked on sticks over an open fire. When the trout is fried to a very crispy state, the entire body, except the head, can be eaten. One individual told that her grandmother used to fry and eat the head, too. Two consultants noted that the head is boiled and eaten. Euler (1966:113) reports one recorded instance, by John D. Lee in 1871, of Southern Paiutes eating fish.

Management Issues

The ethnofaunal study trip was designed as an initial overview and assessment of Southern Paiute concerns about animals in the *Colorado River Corridor*. As discussed earlier, it is difficult for Southern Paiute consultants to assess impacts to animal populations during an eleven day trip during which no more than a couple of hours are spent in any one place. More specific observations about the condition of animal populations and their habitats require a much more intense level of effort than was possible with 1995 funding. Therefore, these observations and recommendations are preliminary pending further study.

When participating in individual interviews about specific animals, Southern Paiute consultants were asked to discuss the condition of the animals' habitats and whether they perceived that the animals or their habitats were being impacted. They were also asked whether any efforts should be made to affect the number of animals in the region and their recommendations, if any, for protecting the animals and their habitats. The data are summarized in Table 2.5.

Table 2.5. Southern Paiute Perceptions of Impacts to Animals and Whether Anything Should be Done to Affect the Number of Animals in the *Colorado River Corridor*

	Perceive Human Impacts to Animal/Habitat?			Perceive Natural Impacts to Animal/Habitat?			Something Should be Done to Affect No. of Animals?		
	Y	N	DK-NR	Y	N	DK-NR	Y	N	DK-NR
Mammals	18	18	4	17	19	4	16	14	10
Birds	10	10	1	5	16	0	8	11	2
Reptiles	2	1	0	0	3	0	0	3	0
Amphibians	0	1	0	1	0	0	1	0	0
Fish	2	1	1	2	0	2	1	2	1
Total	32	31	6	25	38	6	26	30	13

As shown in Table 2.5, no strong patterns emerged in the data. Consultants were fairly evenly split over whether or not they perceived impacts to the mammals, birds, and fish and in whether or not they believed anything should be done to increase the numbers of any particular species of these animals in the canyon. There are not enough data to say anything about amphibians. The consultants generally perceived there were no natural impacts to reptiles or birds; they were split on whether or not they perceived human impacts to these animals.

A careful look at the data regarding impacts and suggested actions is informative. Consultants were asked to provide recommendations for protecting animals from *human impacts*. The most common response was simply, "Leave them alone." More specific responses have been categorized, as shown in Table 2.6. Some individuals did not suggest any recommendations for protecting animals within the *Colorado River Corridor* or stated that they did not believe

Table 2.6. Southern Paiute Recommendations for Protecting Animals from Human Impacts

Category of Response	Examples of Responses in this Category	Affected Animals	Number of Responses (N=69)
Leave Them Alone	Leave them alone and let them be on their way Let them be at peace Let them be and they won't bother you Just leave them alone	bald eagle, bighorn sheep, leopard frog, mountain lion, mourning dove, mule deer, porcupine, prairie dog, rabbit	16
Prohibit Hunting	Don't let anybody hunt Keep poachers away	antelope, bald eagle, bighorn sheep, mallard duck, mule deer, wild turkey	11
Restrict Places Visitors Go	Rules to stop people from visiting caves (bats) Hikers should be restricted Keep tourists away from them	bats, bighorn shep, chuckwalla, mallard duck, mule deer	7
Limit Development, Visitation, Air Traffic	Laws, ordinances to limit activity near their land (bald eagles) Not allow development Limit air traffic and tourism in canyon Limit traffic coming down river	bald eagle, great horned owl, mule deer	6
Control Visitor Behavior	Don't let tourists hit them Don't chase them Put out signs not to bother them	mule deer, rock wren, trout, wild turkey	5
Monitor	Check on them Make Indian fish and game wardens to keep an eye on it	antelope, bald eagle	2
Limit Fish Catch	Limit number of fish caught	trout	1
Total			48

there was anything that could be done to protect the animals from human impacts.

> You can't tell people to stop what they're doing now. They wouldn't understand.

> None - it would be hard to implement.

The vast majority of consultants had no recommendations for protecting animals from *natural impacts*. Their responses include both observations that animals do not need to be protected from natural elements and that, even if they did, there is nothing humans can do to protect them from such elements. The following responses are typical:

> They'll survive in anything. The only enemy they have is a hunter and a trapper.

> They're expected to live like that. Just leave them alone.

> There is no way we are ever going to keep the rain from coming.

Only 7 of 69 responses included recommendations for protecting animals from natural elements. Those responses are shown in Table 2.7.

Table 2.7. Southern Paiute Recommendations for Protecting Animals from Natural Impacts

Category of Response	Examples of Responses in this Category	Affected Animals	Number of Responses in this Category (N=69)
Monitor Animals	Have somebody watch over them like rangers Protect and watch until herd gets larger	antelope, bighorn sheep, mule deer	3
Alter Habitat	Revegetate areas here Maybe move habitat higher	mourning dove, porcupine	2
Predator Control	Watch them and control the population of coyotes	rabbit	1
Increase Number of Individuals	Replace them - that is what the white man does now	trout	1
Total			7

Although more than one third of the respondents said that something should be done to *affect the number of animals* in the canyon, almost one half of those individuals described non-intrusive activities such as watching it, protecting it, and not doing anything to bother it (see Table 2.8). The remaining responses include introducing new individuals to the canyon population, tagging existing individuals, and altering the habitat by either putting out salt (for deer) or a general statement to "try to make them live" in the area.

Table 2.8. Actions Suggested by Consultants Who Believe Something Should be Done to Increase the Number of Animals Living in the *Colorado River Corridor*

Suggested Action	Number of Individuals Suggesting It (N=26)
Watch, protect, don't do anything to bother it	12
Introduce new individuals to population	8
Tag individuals within a population	5
Alter the habitat	2
Total	27*

*One consultant recommended both introducing new individuals and tagging existing ones

SUMMARY AND CONCLUSIONS

The ethnofaunal study provides a sound basis for future work on the cultural significance of animals in the *Colorado River Corridor* to Southern Paiutes. Data from this study are useful for understanding the meaning and uses of animals to Southern Paiutes in this area before the Glen Canyon Dam was constructed and to understand how dam-derived changes potentially impact these animals, their habitats, and the Paiute people who used them. Data were collected from interviews along the *Colorado River Corridor* and from documents recording historic interviews with Southern Paiutes. Information was collected about what are perceived by Paiutes to be 66 different animals.

Both individual and group interviews along the *Colorado River Corridor* provided useful and unique information for the study. During the interviews, the consultants used photographs to help them remember uses for various animal parts and to point those out to the ethnographers. The presentation of photographs or even museum specimens of animals has been found to be only somewhat adequate for capturing individuals' ethnobiological knowledge of even well-known species (Berlin 1992). In particular, methods that tap into consultants' knowledge about animal behavior, such as bird songs, are also needed. During the April 1995 study, one interview was initiated after a consultant heard a bird singing at dawn; the consultant had not selected the bird when looking at its photograph.

Information about the Southern Paiute biological classification of animals gathered from this study is incomplete. Only mammals and birds were reviewed animal by animal, and information about overall classification of animals was derived from looking at specific animals and working outward rather than having Southern Paiute consultants begin by describing their method of classifying animals. A study of general animal classification requires a revised methodology.

Finally, Southern Paiute consultants could make general statements about natural and human impacts to animals and their habitats in the CRC. These recommendations are preliminary, pending the development and implementation of more extensive research and monitoring, especially of human impacts. In general, Southern Paiutes recommend no effort be made to protect animals from natural impacts. Many impacts, such as flash flooding and beach erosion, actually have human causes and must be more carefully studied. Direct human impacts, such as tormenting or killing animals, are caused by Canyon visitors. Southern Paiute consultants recognize that animals receive protection within the Grand Canyon National Park and support that protection. Additional recommendations, such as restricting the number of canyon visitors and the places they can visit, require further attention.

CHAPTER THREE

SOUTHERN PAIUTE CULTURAL RESOURCE MONITORING IN THE *COLORADO RIVER CORRIDOR*

Long range monitoring of cultural resources is an important aspect of the management of the *Colorado River Corridor*. The research conducted by the Southern Paiute Consortium (SPC) includes studies of archaeology and botany (Stoffle, Halmo, Evans, and Austin 1994), rock art (Stoffle et al. 1995), and animals (Chapter Two of this report) and provides valuable information regarding Southern Paiute perspectives of their cultural resources, the Colorado River, and the Grand Canyon as a whole. The Southern Paiute tribal representatives who participated in these studies have expressed their concerns about the condition of specific cultural resources in the *Colorado River Corridor*. They and their tribal governments have presented a series of recommendations to mitigate adverse impacts to these resources (Stoffle, Halmo, Evans, and Austin 1994; Stoffle et al. 1995, Chapters Two and Six of this report). In all studies, Southern Paiute people have recommended that cultural resources in the study area be protected from adverse impacts resulting from projects and programs within the region.

Within U.S. federal law and for both state and Federal land management agencies, the human and natural components of the landscape are "resources" to be "managed." Land managing agencies are governed by laws, regulations, and guidelines associated with the scientific identification, evaluation, and management of "cultural resources." Therefore, the term *cultural resources* will be used to refer to elements of the Southern Paiute cultural landscape. Within the past few years, many land managing agencies in the U.S. have sought to increase consultation with Native American people about cultural resources within the land under their jurisdiction. Too often, Native Americans are put into a forced-choice decision process in order to single out specific "cultural resources" to protect rather than larger areas within which these resources are located. By considering the cultural concerns of the Southern Paiute people as well as the professional concerns of archaeologists and biologists, land managers can begin to effectively and comprehensively manage cultural resources in the *Colorado River Corridor*.

From the perspective of Southern Paiute people, *cultural resources* are intricate parts of larger culturally perceived geographic areas (see Stoffle et al. 1995, Chapter Four). For example, when Southern Paiute representatives were asked about the uses and significance of specific cultural resources in the *Colorado River Corridor*, they generally decided to talk about spatially large places rather than specific cultural resource *sites* (Stoffle, Halmo, Evans and Austin 1994). To Southern Paiute people, the resources in the *Colorado River Corridor* are simply one element of their *cultural landscape* in which humans, nature, and the supernatural are all integrated into a single whole. Consequently, Southern Paiute representatives seek to protect all elements of the cultural landscape, including plants, animals, water, and minerals, rather than to only protect specific cultural resource sites. Attempts to monitor impacts to Southern Paiute cultural resources in the *Colorado River Corridor* must therefore document changes occurring to a number of elements of the cultural landscape as well as to the landscape as a whole.

Information about the condition of cultural resources can be entered into a Geographic Information System (GIS) database for management oriented analyses. A number of potentially useful GIS analyses are discussed below. Changes occurring to cultural resources can be monitored by the use of field techniques or through the analysis of remotely sensed images. These methods are described in more detail in the following sections. The choice of monitoring techniques is dependent on the scale required to adequately understand change occurring to a particular cultural resource.

This chapter includes (1) a brief background of the Glen Canyon Environmental Studies-Geographic Information System (GCES-GIS), (2) one possible framework for developing a Southern Paiute cultural resource monitoring program, and (3) information about the development of a multimedia database of Southern Paiute cultural resources. The monitoring program is built around the concerns that Southern Paiute representatives have expressed about archaeological, botanical, and rock art sites in the *Colorado River Corridor* and their recommendations for protecting these resources (Stoffle, Halmo, Evans, and Austin 1994; Stoffle et al. 1995). Continued research by and consultation with Southern Paiutes is expected to reveal additional areas of concern.

SOUTHERN PAIUTE RESOURCES AND THE GCES-GIS

A Geographic Information System (GIS) is an invaluable tools for measuring change over time because it allows diverse kinds of information about both the natural and human made environments to be managed and archived in one central database. A GIS is an organized collection of computer hardware, software, and geographic data designed to efficiently store, update, analyze, and display geographically referenced information (Dangermond 1991:11). GIS software performs a number of functions that are very useful for the long range monitoring of natural and cultural resources. These include overlaying different kinds of geographically referenced data, performing statistical and geographic correlations, creating buffers around geographic features such as cultural resources, and conducting spatial searches, change image analyses, and analytical modeling. One of the most useful features of a GIS is that it permits both cultural and natural resources to be managed on an ecosystem level. This management framework accords well with the cultural perspective of the SPC towards the *Colorado River Corridor*.

The need to incorporate the concerns of American Indian people and members of the general public resulted in the development of the GCES-GIS database for long term monitoring of the impacts of variable flow rates from Glen Canyon Dam. Long term monitoring is defined here as "measuring the change over time in vegetation, geology, cultural resource areas, and habitat for rare and endangered species every 3 to 5 years" (GCES 1994:19). The GCES-GIS was designed to allow resource managers to monitor natural and cultural resources in the *Colorado River Corridor* and to serve as an archival database for information concerning the area and its resources. The SPC contributes to this monitoring process by identifying the location and size of areas of concern in the *Colorado River Corridor* and providing monitoring data about these areas to the GCES for integration into the GIS. Monitoring makes it possible for tribal representatives to determine the type and extent of impacts occurring to their cultural resources. By integrating monitoring data into the GCES-GIS, the SPC can also evaluate how these impacts are related to dam operations and the management of the river ecosystem.

A GIS can produce both cartographic and tabular output regarding geographic features. Geographic features are elements of the physical landscape such as mountains, buttes, or archaeological sites. Cartographic data, such as maps, are stored in raster or vector formats and contain the topology or "anatomy" of geographic features. Information pertaining to these various geographic features, such as slope and soil type, is stored as attributes (also referred to as "characteristics of a geographic feature") in tabular computer files that are linked to the particular geographic feature.

Any type of cartographic or tabular data received by the GCES, including information about Southern Paiute cultural resources, must be converted into the GIS in a consistent geographically referenced format (GCES 1994). In other words, cultural resources, such as archaeological sites, must be accurately located on the planet earth relative to other geographic features, such as mountains or buttes. Geographic referencing of field-surveyed data can be accomplished through conventional surveying techniques or the use of Global Positioning Systems (GPS). Georeferencing remotely sensed data is usually accomplished through the use of ground control points. GISs make use of a number of geographic reference systems including longitude and latitude, Universal Transverse Mercator (UTM), and State Plane coordinates. Once a given data set is geographically referenced it can be imputed into the GIS for analyses in relation to other geographically referenced data sets. For example, changes occurring to archaeological sites that are recorded as part of the monitoring program can be analyzed in relation to erosion models, water flow, or levels of human traffic.

Data about geographic features such as cultural resources can be obtained from existing maps, field surveys, or from remotely sensed images. At least some monitoring data will be obtained through field surveys. However, the bulk of geographic information that is integrated into a GIS is usually acquired from remotely sensed images. Remote sensing is the acquisition of data about an object from a device that is not in direct contact with the object. Examples of remotely sensed images are photographs taken from airplanes and satellites. These images can provide the resource manager with a plethora of information about the natural and human made landscape. For example, topographic information showing the height and shape of mountains can be taken from these images.

There are many sources and archives of remotely sensed images that are available to the public. Some of the most common sources are listed below.

(1) United States Geological Survey (USGS) EROS Data Center. This center is an archiver of all the Landsat imagery, including Multi-Spectral Scanner (MSS) images at 80 meter resolution per pixel and Thematic Mapper (TM) imagery at 30 meter resolution per pixel. The USGS also produces products called "Digital Elevation Models" (DEM) of both their 1 degree (approximately 100 meter resolution) and 7.5 minute (30 meter resolution) topographic quads. The Geographic Land Information System (GLIS), which is a subunit of the EROS Data Center, contains information about 38 sources of data regarding the Earth's land surfaces. There is a wide variety of digital images available from GLIS, including land use/land cover digital cartographic files of the entire U.S. The EROS data center is located in Sioux Falls, South Dakota.

(2) The National Aerial Photography Program (NAPP). The NAPP is designed to acquire black and white or color infrared photography at a scale of 1:40,000 (1 inch on the map equals 40,000 inches on the ground). This data is available through the EROS Data Center or the Aerial Photography Field Office in Salt Lake City, Utah.

(3) SPOT Image Corporation. This company provides commercial access to imagery with 20 meter resolution per pixel that was acquired from the series of commercially developed SPOT satellites. The SPOT Image corporation is located in Reston, Virginia.

(4) Private Companies. There are a number of companies that will produce digital map images for users who do not have the technical expertise or resources to manipulate raw data into usable sources of information. Three of these companies are: (1) Environmental Research Institute of Michigan (ERIM) located in Ann Arbor, Michigan; (2) Environmental Sciences Information Center (ESIC) located in Tucson, Arizona; and (3) Positive Systems, Inc. based in Kalispell, Montana. These companies can also produce digital maps from aerial photographs they acquire themselves, although the cost is generally very high.

The Bureau of Reclamation's Remote Sensing Center in Denver, Colorado, in cooperation with Horizons, Inc., has provided the GCES-GIS numerous remotely sensed images of the *Colorado River Corridor*. Maps created from aerial photographs that have been geographically referenced and rectified (orthophotos) exist for the entire *Colorado River Corridor* in relation to the United States Geological Survey's 1:24,000 quad sheets (one inch on the map equals 24,000 inches on the ground). In addition, the entire river corridor of 291 miles was photographed with 1:2,400 color infrared (CIR) film for mapping natural resources.

Limited funds and time constraints prevent the GCES from monitoring the entire *Colorado River Corridor*. A GCES-GIS work group that included Federal and state agency representatives, Native Americans, and members of other groups identified 15 *Long-Term Monitoring Sites* that would be the focus of the long range monitoring plan, special studies, and the archive (see Appendix C). These Long-Term Monitoring Sites were selected because they represent the ecological diversity in the *Colorado River Corridor* or are areas of critical resources or where special studies have been done (Werth et al. 1993). Orthophoto maps at 1:2,400 scale were created for each of these 15 Long-Term Monitoring Sites. These orthophotos contain cartographic data that cannot be obtained from the color infrared photos. The color infrared photos were then overlayed with the orthophotos to create hard copy maps (at 1:2,400 scale) for each of the 15 Long-Term Monitoring Sites. These maps were digitized and transferred into the GIS so the data they contain could be analyzed in relation to other data sets. This dataset has a horizontal accuracy of 2.0 meters and vertical accuracy of 1.0 meter.

Other terrestrial, aquatic, and sediment data gained from either ground based surveys or other remotely sensed images is being collected and integrated into the GIS for each of these Long-Term Monitoring Sites. In addition, more detailed types of data for specific large scale study areas is being obtained from field surveys. For example, botanical surveys have provided locational information about specific plant species within monitoring site number four (see Appendix C). Frequently, these data have been acquired from members of the scientific community who have been doing research in the *Colorado River Corridor* and have provided the GCES with their data for incorporation into the GIS. Survey referenced data can produce digital data with sub-centimeter accuracy.

The GIS software used for the GCES-GIS database is ARC/INFO. This software runs on workstations using a UNIX operating system. The SPC, however, utilizes DOS based personal computers. This is not a serious problem because both cartographic and tabular data can be transferred into and out of the GCES-GIS in a number of UNIX or DOS based formats. The exact procedures that should be followed for transferring both tabular and cartographic data into and out of the GIS are outlined in the GCES's *Geographic Information System Information Guide and Operating Protocol* (GCES 1994). The SPC has used *Lotus 1-2-3* for data storage and analysis and this program can also be utilized to code the Southern Paiute cultural resource monitoring data.

THE MONITORING PROCESS

Historically, the monitoring of cultural resources has not been the focus of much research or concern among scientists or resource managers, largely due to lack of funds. Funding has tended to be funneled towards the acquisition of baseline data, such as Phase I surveys of archaeological sites. Management of these resources has generally been limited to mitigation of impacts. Recently, as more extensive studies of cultural resources have been conducted and incorporated into computer databases, there has been a consequent shift from mitigation to monitoring as a management strategy.

David Cole (1989) developed a widely used sourcebook of monitoring methods. The monitoring system Cole describes provides a very useful outline for the development of a SPC cultural resource monitoring program. Cole's sourcebook is especially useful for the purposes of cultural resource monitoring in the *Colorado River Corridor* because it discusses issues involved in monitoring sites in remote wilderness areas. Monitoring cultural resources requires a clear conception of how the information acquired during the monitoring process will be used. In this project, data obtained from fieldwork and remote sensing will be used to document the changes occurring to Southern Paiute cultural resources in the *Colorado River Corridor*. Changes should be evaluated in light of the concerns and recommendations that the SPC has expressed about the landmarks and other elements of the cultural landscape in the area. If the impacts are severe enough to warrant action, certain procedures, which are discussed below, should be followed for dealing with these impacts. Data about the most important impacts should be transferred into the GCES-GIS for the purposes of spatial analysis and long-range monitoring. The monitoring process described in this chapter is divided into three steps, based on those described in Cole's sourcebook. These steps are outlined below and then are discussed in more detail in the following sections.

The first step in the development of a SPC monitoring program is choosing what cultural resources to monitor. This choice is guided by a number of factors including location and the concerns and recommendations of Southern Paiute people. After specific cultural resources have been chosen for monitoring, the second step is to determine for each resource the types of impacts to be monitored and clearly defined parameters used to measure these impacts. In this step, what actually will be monitored either in the field or through the use of remotely sensed images is determined.

The final step in developing a monitoring program is determining what methods best suit the kinds of impacts that are to be monitored. The choice of monitoring procedures is often limited by time and resource constraints. The monitoring system that is eventually adopted should tell the SPC as accurately as possible, for the most important impacts, the extent to which change has occurred (Cole 1989:2).

Choosing Monitoring Sites

Effective resource monitoring begins with a systematic inventory of the kinds of resources to be monitored. This baseline data serves as the foundation upon which changes occurring to Southern Paiute cultural resources can be understood over time. It also serves as a starting point for deciding what resources to monitor. Existing inventories of four different types of cultural resources in the *Colorado River Corridor* are provided below. Once the available information has been assessed, a number of factors that may limit the particular cultural resources that can be monitored must also be considered. These factors are discussed below.

The geographic extent of the GCES's long-range monitoring program guides the choice of cultural resources that can be monitored. The GCES-GIS monitoring plan was designed to include only those Southern Paiute cultural resources in the zone affected by the Glen Canyon Dam water release, which is defined as all riverine environments within the *Colorado River Corridor*. This zone includes the present beaches up to and including the farthest extent of the old high water zone marked by high dunes and mesquite. Any cultural resources that fall outside this zone must be specially entered into the system.

In addition, there are a number of logistical factors that must also be considered when choosing which Southern Paiute cultural resources to monitor in the *Colorado River Corridor*. For example, the proximity of one cultural resource to another must be considered. This is important because SPC monitors must make the most effective use of limited time and resources while in the field. Ultimately, it is the concerns and recommendations that Southern Paiute people have expressed about each type of cultural resource that must be considered when choosing which resources to monitor. Although the ultimate goal of the monitoring program is to define and monitor cultural resource sites, ethnographic studies have been conducted on specific cultural resources, such as archaeological sites or plants. Therefore, these resources are discussed separately in the following sections.

Archaeology

A draft archaeological survey report entitled *The Grand Canyon Corridor Survey Project: Archaeological Survey Along the Colorado River Between Glen Canyon Dam and Separation Canyon* (Fairley et al. 1994) was produced by archaeologists at Northern Arizona University and Grand Canyon National Park (GCNP) in cooperation with GCES. The site descriptions in this report include information on surface surveys, partial excavations, and artifactual and feature analyses. Out of the 475 total recorded archaeology sites in the *Colorado River Corridor*, 50 of these sites have been identified by archaeologists as either Paiute or Pai. As part of the ethnographic inventory and assessment of Southern Paiute cultural resources in the *Colorado River Corridor*, 36 of the sites identified as either Paiute or Pai in the archaeological survey were visited by Southern Paiute representatives (Stoffle, Halmo, Evans, and Austin 1994).

In the GCNP's archaeological report, each site was recorded, mapped to scale and photographed. The GCNP staff utilized (1) photographic documentation, (2) detailed and accurate maps of sites in relation to topography, (3) comprehensive assessment of site conditions and impacts, and (4) detailed information on the quantity, density, and variability of surface artifacts (Fairley et al. 1994:15). All site localities were plotted on both USGS 7.5 minute topographic maps and the GCES 1989 series of black and white aerial photographs. This data set has provided the basis from which changes occurring to archaeological sites can be monitored.

Limited time and resources prohibit the SPC from monitoring all the archaeological sites of concern to Southern Paiute people. It is therefore necessary to limit the number of sites that will be monitored. One possible solution is to restrict monitoring to either the 36 sites already visited by Southern Paiute representatives or to the 50 archaeological sites identified as Paiute or Pai by the archaeological survey. However, it is necessary to consider a number of other factors that reflect the concerns and recommendations of the SPC.

The Southern Paiute representatives expressed particular interest in a number of archaeology sites and requested that they receive special monitoring attention. The SPC has recommended that access to these sites be restricted, so any field monitoring must proceed carefully to minimize impacts to the site. Two of these sites are the "women's healing site" at Bedrock Canyon [AZ:B:11:282-Stop #22, near Mile 130] and four sites at Granite Park [AZ:G:3:26, AZ:G:3:27, AZ:G:3:28, AZ:G:3:3-Stop #22, near Mile 209].

Another important consideration when choosing archaeology sites to monitor is their proximity to other resources of concern to Southern Paiute people. Research has indicated that Southern Paiute people perceive sites as consisting of more than just archaeological materials and other remains (Stoffle, Halmo, Evans, and Austin 1994:193). Broader perceptions of an archaeology site include natural resources such as plants, animals, and water in a larger spatial area than the more narrowly bounded "site" in archaeological terms. One way of assuring that this holistic view of cultural resources is taken into account is to monitor a number of cultural resources that are in close proximity to and pereived to be culturally linked with each other. Linked sites could include archaeological sites where Paiute people lived and places having food and medicine plants needed to sustain life. The types of features found at archaeology sites (as identified by Stoffle, Halmo, Evans, and Austin 1994:194 and Fairley et al. 1994:23-24) might also serve as a possible way of prioritizing what sites to monitor.

Three additional factors may be considered before choosing archaeology sites to monitor. These are listed below by level of importance.

(1) *Proximity to Water*. Archaeology sites closest to the water might be the most seriously affected by water release and therefore might require special monitoring attention. This factor cannot be considered until accurate measurements of proximity for each site are obtained (see **Monitoring Methods** below).

(2) *Type of Site*. The GCNP archaeology report identified 25 different types of archaeological sites in the Grand Canyon (Fairley et al. 1994:21-22). These types may help prioritize sites to monitor. For example, should burials receive special considerations when choosing monitoring sites? The degree of cultural significance that is assigned to a particular type of archaeology site might also help prioritize sites to be monitored. However, the vast majority of Southern Paiute representatives who participated in the ethnographic field trips believed that all the archaeology sites they visited were highly significant.

(3) *Function of Site*. Southern Paiute representatives have identified five principal uses for archaeology sites. These include farming, hunting/camping, ritual/ceremony, gathering foods, and trade (Stoffle, Halmo, Evans, and Austin 1994:174). Sites could be chosen to include examples from each category.

The GCNP began to monitor archaeological sites on a yearly basis in 1991. Consequently, the GCNP already has data from which they can prioritize the choice of sites to monitor. The four main factors used by the GCNP when choosing the priority of archaeological sites to be monitored include (Coder, Leap, Andrews, and Hubbard 1994):

* present levels of natural impacts
* accessibility to the public
* degree of risk based on setting and proximity to the river
* current condition of each site

These factors are almost identical to the concerns that Southern Paiute people have expressed about their cultural resources in the *Colorado River Corridor*. The SPC therefore will have to do additional monitoring of archaeology sites if two conditions are *not* met. First, does the list of archaeology sites monitored by the GCNP include all the sites of concern to the SPC? Second, are the methods used by the GCNP to measure impacts to archaeology sites sufficient to include all SPC concerns (see Appendix D)?

Plants

Around 1,400 species of plants have been identified in the Grand Canyon (Phillips, Phillips, and Bernzott 1987). The ethnobotanical study of Southern Paiute plants (Stoffle, Halmo, Evans, and Austin 1994) identified 205 plant species at 21 sites in the *Colorado River Corridor*. Of these 205 species, 68 were identified as culturally significant by the Southern Paiute participants. Although Southern Paiute people would prefer that all plants in the *Colorado River Corridor* be preserved, those plants identified as culturally significant are a priority for monitoring. If a particular culturally significant species of plant cannot be protected, the same plant species must be preserved at another location. Areas where the same plants exist may be identified through the use of the GCES-GIS. This type of analysis depends on the detail of information available to the GIS. In order to identify areas where specific species of plants exist, that information must be available as a georeferenced dataset in the GIS. At this time, only groups and not specific species of vegetation associated with the old and new high water zones have been integrated into the GIS for the 15 Long-Term Monitoring Sites (see Werth et al. 1993:39).

The Southern Paiute representatives expressed special concerns about an ancient Goodings willow at Granite Park. This specific tree should be given special monitoring consideration.

Other important factors to be considered in determining which plants to monitor are listed below.

(1) *Proximity to Water*. Fluctuating river levels are perceived to be causing the uprooting of plants and otherwise affecting plant communities. The loss of native plants is viewed by the Southern Paiute representatives as very damaging. This factor cannot be

considered until accurate measurements of proximity for culturally significant plants are obtained (see **Monitoring Methods** below).

(2) *Degree of Cultural Significance*. Both the Index of Cultural Significance (ICS) and Ecozone Significance (ES) scores (taken from Stoffle, Halmo, Evans, and Austin 1994:270, 277) should be taken into account when choosing plants to monitor. Because the new and old riparian zones had the highest ES scores, plants in these ecozones have the highest monitoring priority. The SPC should also consider whether they would like to monitor plants that represent a range of ecozones.

Rock Art

Twenty-three rock art sites have been visited by Southern Paiute representatives in the *Colorado River Corridor* (see Stoffle et al. 1995). All of these culturally significant resources should be monitored, if possible. The rock art site at Nine Mile Draw [Site #C:02:038] was damaged over the summer of 1994 and has been noted as an ARPA violation (see Figure 3.1). This site should receive special monitoring attention.

Figure 3.1. Vandalism at Ninemile Draw petroglyph site. Note the recent addition in 1994.

Traditional Cultural Properties

Southern Paiute representatives also expressed concerns about a number of traditional cultural properties (TCP) located in the *Colorado River Corridor*. TCPs are places that have special religious, sacred, or historical significance to Southern Paiute people (Parker and King 1990:1; Stoffle et al. 1995). Such places often lack associated artifacts, so their identification depends on statements by the people who define them as culturally significant. These are sites that are particularly sensitive to Southern Paiute people. The following TCP sites should receive special monitoring attention.

(1) *Ompi* (Hematite) Cave
(2) Salt Cave
(3) Deer Creek Valley and Falls
(4) Vulcan's Anvil
(5) Granite Park
(6) Pumpkin Spring

Animals

Systematic ethnofaunal studies involving Southern Paiutes were not begun in the *Colorado River Corridor* until 1995 (see Chapter Two). Consequently, insufficient data was available for developing a systematic approach to animal monitoring. Nevertheless, animals have considerable cultural and religious significance to Southern Paiute people. Birds, such as eagles, are perceived as important and are prayed to and talked with when captured. Future monitoring plans should include Southern Paiute ethnofaunal resources.

Determining Types of Impacts

Once specific cultural resources are chosen to be monitored, the kinds of impacts that are of concern to Southern Paiute people must be identified. For example, if plant productivity is determined to be a concern, potential impacts may include uprooting and trampling. Evaluations of a number of potential impacts, such as uprooting and trampling, can be used together to assess the condition of a given cultural resource and/or of an entire monitoring site in the *Colorado River Corridor*. The integration of such monitoring data into the GCES-GIS's long range monitoring effort allows Southern Paiute concerns to be considered in the management of this important area.

In order to accurately measure changes occurring to Southern Paiute cultural resources, a number of discrete parameters must be developed. These parameters outline the different levels of change that could occur to a cultural resource as a result of a potential impact. For example, uprooting at a given cultural resource site could be non-existent, light, moderate, or severe (see *Condition Class estimates* under **Monitoring Methods**). Each of these levels of uprooting is defined by a specific numerical range of plants.

Southern Paiute cultural resources in the *Colorado River Corridor* are potentially impacted by both natural processes and human activities. Natural and human impacts are perceived very differently by Southern Paiute people (see Stoffle et al. 1995), so the monitoring form that is eventually adopted by the SPC should separate the kinds of impacts to be monitored according to their source. Identifying the source of impacts occurring to Southern Paiute cultural resources also is essential for mitigating present impacts and preventing future ones.

Natural impacts include the effects of biotic, hydrologic, and geologic processes on cultural resources. Erosion is the most significant natural factor impacting cultural resources in the *Colorado River Corridor*. However, the primary cause of the ongoing erosional problem in the *Colorado River Corridor* is the restricted flow of water through Glen Canyon Dam, a human made feature (Coder, Leap, Andrews, and Hubbard 1994). Other human impacts are caused by visitors to the area. For example, tourists visiting archaeological sites in the Grand Canyon often collect surface artifacts like pottery sherds and place these into piles on nearby rocks or take them away (see Figure 3.2).

Figure 3.2. Example of a collector's pile, a common sight at archaeological sites in the *Colorado River Corridor*

The construction and continued operation of Glen Canyon Dam has altered the pattern of natural processes and the patterns of human use in the *Colorado River Corridor*. Determining the root cause of impacts is therefore difficult. Many natural processes like surface erosion or bank slumpage are actually caused by human activity. Differentiating between human and natural impacts should be an area of concern in the monitoring program.

General Concerns for Cultural Resources

The SPC has expressed the desire that all their cultural resources in the *Colorado River Corridor* be preserved as they are, not removed or modified in any way (Stoffle, Halmo, Evans, and Austin 1994). This reflects the Southern Paiute people's general preservation philosophy about their traditional lands and the animals, plants, artifacts, burials, and minerals that exist within these lands. In other words, Southern Paiute cultural resources should be *left in place* and, when they cannot be protected from human impacts, access to them *should be restricted.* The following list of monitoring program objectives provides a basis for determining potential impacts that are of concern to the SPC.

* Assess condition of cultural resources
* Identify cultural resources potentially impacted by erosion and other natural processes in order to reduce erosion affecting these resources.
* Monitor disturbance from human visitation
* Monitor effects from water flow, erosion and other natural processes

Potential impacts that are of concern to the SPC for each type of cultural resource are mentioned below. Summary ratings of a number of different impacts can be gained by summing a series of ordinal rankings, essentially the sum of all the measured impacts, or by creating a separate overall measure for an entire site. Acceptable levels of change occurring to each cultural resource and to an entire monitoring site must be determined by the SPC. These levels of acceptability will help to determine when actions must be taken to prevent or mitigate adverse impacts.

Archaeology

There are a variety of natural impacts identified on the existing GCNP archaeology monitoring form that could potentially change the condition of an archaeological site. These impacts include *surface erosion* (*0-10cm* loss of sediment), *gullying* (*10-100cm* loss of sediment), *arroyo cutting* (*>1m* loss of sediment), *bank slumpage*, *eolian(wind)/alluvial(water) erosion or deposition*, *side canyon erosion*, *animal-caused erosion (trailing, burrowing)*, and *other natural impacts (spalling and roots)* (see Appendix D).

Many archaeological sites are in and above the Old High Water Zone (OHWZ), and the Southern Paiute representatives perceive that these are primarily impacted by tourists. Human impacts can include *inundation*, *trampling*, *trailing*, *collection piles*, *vandalism*, *trash piles*, or *on-site camping*. All of these impacts are already included in the GCNP's archaeology monitoring form. The Southern Paiute monitoring form should also include extra space for recording other kinds of human impacts, such as spiritual impacts, that are not mentioned here. Southern Paiute representatives also expressed concerns about the *accessibility* of archaeological sites. The more accessible an archaeology site is to tourists the more likely it is perceived to have adverse impacts.

The GCNP's FY93 archaeological monitoring report concluded that the degree of human impact varies according to the time of year (Coder, Leap, Andrews, and Hubbard 1994:1). Sites exhibited more impacts from visitation during the late summer and early fall. These human impacts included trailing, trampling, and trash. On the other hand, in February and March sites exhibited less human impact because they had the late fall and winter to recuperate. When deciding on what time of year to monitor, the SPC should take these observations into consideration.

Trailing is the most frequent human impact observed by the GCNP and has the "greatest potential for long-term damage to cultural properties" (Coder, Leap, Andrews, and Hubbard 1994:4). Accelerated erosion throughout the *Colorado River Corridor* has caused the subsequent incremental loss of archaeological sites (Coder, Leap, Andrews, and Hubbard 1994). Archaeological sites in sand banks between the river's edge and old high water mark are the most seriously affected by erosion. A number of elders expressed the belief that it is appropriate for the things of the old people, such as archaeological sites, to naturally decay *in situ*. The monitoring of archaeological sites might therefore concentrate on human impacts rather than natural ones.

Plants

The loss of native plants from erosion is viewed by the Southern Paiute representatives as happening more often than the erosion of archaeological sites from the sand banks. Fluctuating river levels are perceived to be causing the *uprooting* of plants, a most serious impact. Southern Paiute representatives perceived that the primary human impacts occurring to culturally significant plants were *trampling*, *clearing*, and *picking*. *Accessibility* by tourists to areas where Paiute plants grow was an additional area of concern. Overall, the *physical and spiritual health* of native plants was a major concern.

Rock Art

There are numerous natural and human impacts that could potentially affect rock art sites, but only the most frequent are identified here. Natural impacts include *surface water (direct water erosion, mineral accretion, and frost damage)*, *salt deterioration*, *soil cover*, *vegetation*, *microflora*, and *animals* (Lambert 1989). The number of tourist visits to rock art sites in the *Colorado River Corridor* serves as an index to the potential human impacts occurring at these sites. Potential human impacts include *vandalism*, *graffiti*, *dust cover caused by foot traffic*, and *erosion caused by trailing*. For example, at Nine Mile Draw, erosion was increased at the base of the rock art panel because of trailing (see Figure 3.3). This is also an example of where what appears to be a natural impact was begun by human activity. Factors affecting the level of potential human impacts include *accessibility* and *visibility*; these were areas of concern expressed by the Southern Paiute representatives that affect the amount of visitation.

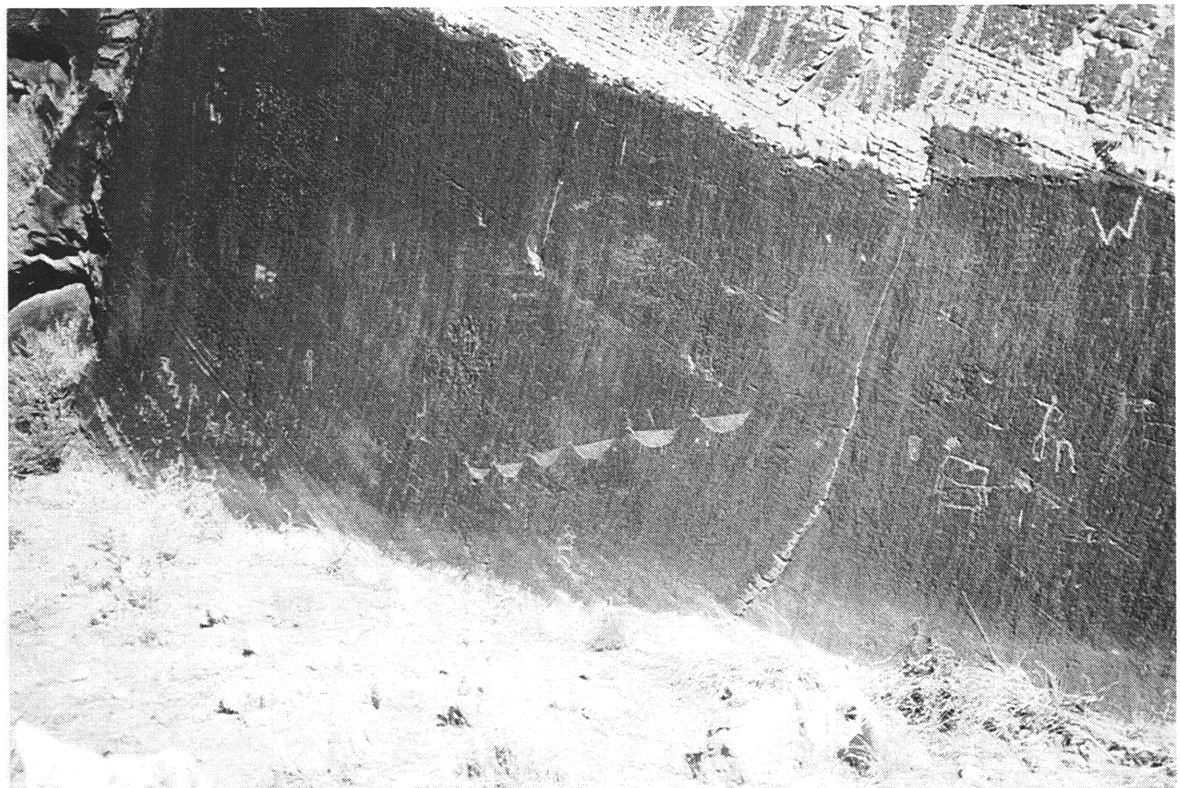


Figure 3.3. Compaction and erosion resulting from people walking near the rock art panel.

Traditional Cultural Properties

The potential impacts that could occur to TCPs depend on the nature of the resource. Some TCPs contain archaeological sites, but generally the concept is restricted to places whose cultural significance derives from the special meaning they have for living people. As such, TCPs tend to be geographically unique places where an event such as a ceremony (either historic or mythic) has occurred. Methods used to monitor these places could be the same as the procedures used for archaeological sites, although spiritual monitoring is often the greatest concern. A landmark like Vulcan's Anvil is a geological feature and consequently requires unique procedures for monitoring. The potential impacts occurring to Vulcan's Anvil are much the same as the natural impacts potentially impacting rock art panels. The condition of large areas like Granite Park, an historic place of refuge for Paiutes, can be evaluated by looking at changes occurring to a number of different cultural resources. In this case, an additional analysis of ecosystem health (see *Ecosystem Monitoring*) might also prove to be useful.

Animals

As additional ethnofaunal data is acquired and analyzed (see Chapter Two), SPC concerns and recommendations regarding animals in the *Colorado River Corridor* can be more specifically integrated into the monitoring plan. These concerns and recommendations will, in turn, be transformed into a number of potential impacts that can be measured to understand the changes occurring to animals in the study area.

Selecting Monitoring Methods

Providing the reader with a variety of methods for monitoring Southern Paiute cultural resources in the *Colorado River Corridor* is one of the primary goals of this chapter. The ways in which cultural resources are monitored reflect the concerns of those involved in their management. The concerns that Southern Paiute people have for their cultural resources are not necessarily the same as archaeologists and other scientific professionals who are put in charge of managing these resources. Alterations to Southern Paiute cultural resources are not only manifested in physical ways but also in cultural ones. For example, changes to cultural resources are perceived by Southern Paiute people as relating to changes occurring to other cultural landmarks, to the Grand Canyon, and ultimately to the planet. Still, methods for documenting and monitoring cultural and natural resources that have been developed by scientific professionals can serve (often without modification) as a foundation for monitoring these "cultural impacts."

There are two primary ways by which changes occurring to Southern Paiute cultural resources in the *Colorado River Corridor* can be measured. These include the use of field methods and the analysis of remotely sensed images. When considering these techniques, available time and resources must be taken into account. The monitoring procedures that are eventually selected by the SPC must also be sufficiently detailed to permit the evaluation of changes in site conditions over time.

A number of field techniques have been developed by Cole (1989). These include (1) photographic documentation from permanent camera points, (2) nonpermanent measures, (3) condition class estimates, and (4) permanent measures. These techniques can be used to monitor all four types of cultural resources described here. *Photographic documentation* is essentially one type of permanent measure and is discussed below in detail in the sub-section entitled *Rock Art*. The other three techniques are described here. These three techniques require the development of a field monitoring form. The GCNP form for monitoring archaeological sites is provided in Appendix D. However, if at all possible, data should be entered directly into a computer while in the field.

Nonpermanent measures are generally qualitative measures of change that include a number of potential impacts to a cultural resource. For example, two potential impacts to a rock art panel include graffiti and erosion. Each individual impact is recorded separately and assigned to a predefined nonoverlapping category of change. A summary impact rating can also be created by summing the different levels of change occuring from each impact (Cole 1989:4). Other potential impacts, such as the extent of vegetation trampling in front of the panel, can be added as it becomes evident that they are important aspects of the panel's condition. This technique allows a large amount of information to be gathered in a short amount of time. Note, however, that neither Cole nor anyone else has incorporated spiritual monitoring into these techniques. *Condition class estimates* are generally qualitative measures of the overall condition of a cultural resource. When using this technique, the presence, absence, or degree of change can be assesed by assigning the cultural resource to a class that most accurately describes its condition. For example, the condition of the rock art panel can be assessed as poor, fair, good, or excellent. Condition class estimates can also be created by combining nonpermanent measures. This technique allows a monitor to summarize the condition of an entire cultural landmark and is fairly rapid.

The major problems with these two methods are (1) uncertainties in measurement, and (2) the inappropriateness of summing a series of ordinal rankings. Measurement errors can be reduced if monitors are given step by step descriptions of how each potential impact should be evaluated. The different levels of change that could occur due to a potential impact should be given precise definitions so there is little room for error. These levels of change should also be tested in the field before they are used in an actual monitoring program.

Permanent measures contain discretely reproducible quantitative impact parameters at permanently located sampling units, such as quadrats, transects, or the entire site. These techniques require much longer periods of time to implement. However, these methods provide a high degree of accuracy and a wealth of information about changes occurring to cultural resources. A number of permanent and rapid monitoring methods are described by Cole (1989:36-57). Detailed measurements can be obtained on a sample of sites to supplement less precise rapid estimates taken on all sites. Methods for quadrat and transect operation can be found in an article by William Degenhardt (1966).

The other method to be considered for monitoring change to Southern Paiute cultural resources is the analysis of remotely sensed images. One way of measuring *accessibility* is by identifying the presence of paths to a given Southern Paiute cultural resource site and how they change over time. By analyzing changes to aerial photos or satellite images taken over a period of time, alterations to the size and length of trails can be determined. The presence of trails in the *Colorado River Corridor* is also highly correlated with the presence of camp sites, which are, in turn, often associated with the location of beaches (see Chapter Six). Fluctuating river levels caused by the operation of Glen Canyon Dam affect the level of bank slumpage, which may potentially alter patterns of beach/camp usage. The level of human traffic at each camp in the *Colorado River Corridor* could be correlated with the levels and types of impacts occurring at Southern Paiute cultural resource sites (see Chapter Six).

Once the geographically referenced location of a cultural resource site, such as a rock art panel, is entered into the GIS, the *visibility* of such a site can be determined through viewshed analyses. These analyses can highlight areas that might require special monitoring attention. Aerial photographs can also be used to determine changes occurring to vegetation (Pucherelli 1988;Waring 1994), although identifying changes to particular species of plants requires the use of ground based surveys. Once the SPC provides the GCES-GIS with accurate georeferenced information about their cultural resources in the *Colorado River Corridor*, these resources can be analyzed in relation to other elements of the GIS such as water flow, erosion, and human traffic.

The scale and resolution of the images that are needed are dependent on what is being monitored and what types of changes are being studied. For example, a satellite image at 30 meter resolution per pixel is not fine enough to decipher changes occurring to a single tree. On the other hand, such a satellite image might be sufficient for measuring changes to an entire plant community or even to hiking trails.

Archaeology

While in the field, there are many ways to assess the condition of an archaeological site. One way is through the comparison of surface surveys of a pre-defined site area. Another method is to monitor change occurring to key artifacts identified by Southern Paiute representatives. Archaeological monitoring can also include changes to artifact density and site area (Fairley et al. 1994:24). Monitoring changes to one or many elements of an archaeology site can be accomplished primarily through (1) the use of quadrats or transects (permanent measures) and (2) the use of non-permanent measures. Quadrats and transects are ideal for gaining accurate estimates of changes occurring to artifact quantity, density, and movement. Condition classes can measure these same type of changes with significantly less accuracy. However, condition class estimates can also be used to identify and measure changes that are less quantifiable and more perceptual in nature.

Both the level and type of natural and human impacts occurring to archaeology sites can be monitored by using photography, through pre-defined condition classes measured by on-site observations, or through the analysis of remotely sensed images. Photography has already proven to be a very useful and efficient method of documenting changes occurring to archaeology sites (see below). Nonpermanent measures will provide the bulk of data acquired by Southern Paiute monitors. The GCNP's archaeology monitoring form already includes a number of condition classes for measuring the affects of natural processes and human activities on archaeology sites in the *Colorado River Corridor* (see Appendix D). If the georeferenced locations of archaeology sites are known, then the susceptibility of these sites to increased water flows, erosion, and human traffic (paths and camps) can be assessed using remotely sensed images. However, proximity to water, the degree of erosion, and level of human traffic occurring at a particular archaeology site can also be measured during on-site observations. Ultimately, a combination of these methods might provide the most accurate monitoring data, given limited time and resources.

The archaeological staff at the GCNP have developed a form to monitor natural and human impacts on a select number of archaeological sites throughout the *Colorado River*

Corridor within the GCNP (see Appendix D). While in the field, the monitoring crew also takes black and white photographs of selected features, examples of erosion, and specific areas of sites at risk. These photos are duplicated each field trip. Black and white photographs are used instead of color for archival purposes. The GCNP has collected over 3,800 black and white images which serve as one of the most important sources of visual information illustrating change for cultural properties and geomorphic processes in the Grand Canyon (Coder, Leap, Andrews, and Hubbard 1994:2). In addition, there are five stationary cameras recording a single color image every day. These cameras have generated thousands of nearly identical images. These color images are stored at Northern Arizona University as part of a beach erosion study. At this time, the fields of vision of these stationary cameras are unknown to the SPC; if significant cultural resources are within these fields of vision, this technique may be useful for Paiute monitoring.

Archaeological monitoring reports are reproduced by the GCNP on a yearly basis. In Fiscal Year 1993 (FY93), 137 separate archaeological sites were monitored (Coder, Leap, Andrews, and Hubbard 1994) out of 475 sites that had been surveyed in 1991 (see Fairley et al. 1994:16-38). The FY93 report included a number of suggestions for future monitoring. The monitoring crew believed that detailed mapping using a total station was warranted for important sites. They also recommended that sampling units to track artifact movement on the surface be established at all monitoring sites. Two other areas that they believed should receive special attention include the quantification of geomorphic change and the stabilization of erosion. The GCES-GIS crew has been hard at work in developing models of geomorphic change of the 15 Long-Term Monitoring Sites they have selected for study (Werth et al. 1993). The stabilization of erosion could possibly conflict with the concerns of the majority of Paiute representatives, who recommended that preservation of cultural resources sites be accomplished without altering the site itself.

Plants

Either individual stands of plants (one species) or plant communities (many species) can be the object of monitoring. Individual stands of plants generally require on-site observations. Measuring change in a small plant stand or community (under 2 meters) through the analysis of remotely sensed images is very difficult. Large plant communities, however, can be monitored both in the field and through the analysis of remotely sensed images. In addition, impacts occurring to entire ecosystems can also be monitored as a means of incorporating the holistic concerns that Southern Paiute people have about the Grand Canyon.

Changes occurring to vegetation have been documented in a number of ways. One of the most effective ways of assessing changes occurring to plants is through the use of photography (see Hastings and Turner 1965; Rogers 1982; Turner 1980). Methodological considerations in using photography for monitoring purposes are discussed in the *Rock Art* section below. Changes occurring to plant communities, plant stands, and even individual plants (such as the Goodings willow at Granite Park) can also be monitored through the use of remotely sensed images. The GCES has produced a series of high resolution maps (at 1:2,400 scale) for the 15 Long-Term Monitoring Sites. Pucherelli (1988) has used aerial photographs to track changes in vegetation cover in both the Old and New High Water Zones. His research indicates a significant increase in vegetation cover in the New High Water Zone from 1965 to 1980 and a significant decrease in cover after the flood in 1983. A recent study (Waring 1994) has evaluated current and historical riparian vegetation trends in the Grand Canyon using multitemporal remotely sensed images at the 15 Long-Term Monitoring Sites. However, both photography and remote sensing serve mainly to complement measurements made in the field using permanent or nonpermanent methods (see **Monitoring Methods** above).

In order to monitor plants for potential uprooting, their proximity to water (i.e. the Colorado River) and susceptibility to potential or existing erosion must be identified. Within the 15 Long-Term Monitoring Sites, the proximity of plants to water and areas of erosion can be measured by analyzing the spatial location of plants in relation to fluctuating river levels and erosion models. Images that display the level of the Colorado River in relation to the riparian environment, have already been developed by the GCES-GIS and are updated on a regular basis. Erosion models for the *Colorado River Corridor* are being developed using remotely sensed images and field surveys. Similar erosion models were developed for Petroglyph National Monument to assess potential erosion occurring to petroglyph and paleontological sites (Phil Guertin, personal communication, 1994). These types of analyses can be used to identify possible and/or existing areas of uprooting from fluctuating water levels. Remotely sensed images also can be used to monitor the accessibility of culturally significant plants when analyzed in relation to trail maps. Culturally significant plants that are identified within one of these susceptible areas can be given priority for monitoring purposes.

Remotely sensed images can be used not only to monitor changes occurring to areas where culturally significant plants have already been identified, but also to identify other areas in the *Colorado River Corridor* that contain the same plant species or communities. One of the biggest difficulties in using remote sensing to monitor plants is the inability to differentiate among species. Some plants live in a community with other plants, while some live spatially separated from other species of plants. Both the identification and analysis of small plant stands or plant communities must be ground-truthed by on-site observations.

Southern Paiute representatives have expressed concerns that humans in the *Colorado River Corridor* are trampling, clearing, and picking culturally significant vegetation. Trampling, clearing, and picking are most accurately monitored through the use of quadrats and transects. These permanent measures can be used in conjunction with nonpermanent measures, which rely on visually identified assessments of less well defined sampling units, to estimate the amount of human impact that has occurred. By using a combination of permanent measures (quadrats and transects) and nonpermanent measures to measure changes occurring to vegetation in the *Colorado River Corridor*, Southern Paiute monitors will increase the accuracy and reliability of their measurements. Choosing where to place the quadrats or transects will require considerable forethought. Permanent measures like these could be used to measure changes occurring to the most important plant stands and communities, to plant communities that are indicators of ecosystem health, and to plants that reflect either the most important or the largest range of ecozones. Sites that eventually are chosen for plant monitoring should include all culturally significant plants and species.

Trampling, picking, and clearing can cause changes in soil conditions as well as in vegetation growth (Sun and Liddle 1993:497). These human activities can specifically cause a reduction in species composition (diversity), species number (abundance), plant biomass, and plant height. When monitoring plants for impacts from human activities, Sun and Liddle (1993) measure the number of species present, the amount of soil penetration resistance, and vegetation height, and visually estimate the total number of all the plants and number of each individual species (abundance). They created four classes of sampling units from these measurements. These classes included areas that were untrampled, slightly trampled, moderately trampled, and heavily trampled. All four classes were characterized during initial survey trips and were used to determine rates and levels of change occurring to vegetation. According to Cole (1987), soil compaction can be used as a surrogate measure of trampling intensity. Cole used a soil penetrometer to measure soil bulk density and soil penetration resistance, which were surrogate measures of the degree of wear to plants because of trampling. These instruments are easy and quick to use (see Liddle 1973).

Cole (1992:256) has developed a useful and simple method to determine areas of vegetation loss at wilderness campsites. The most significant impacts included in his study are those caused by trampling (human impact), disruption of organic soil horizons (natural impact-erosion), and compaction of mineral soils (human impact). Cole looks solely at the impact of trampling on *vegetation loss*. The absolute vegetation loss is calculated by subtracting the mean vegetation cover on the sampling unit from the mean cover on a comparable undisturbed sampling unit. The actual area of vegetation removed is calculated by multiplying the absolute vegetation by the area of the sampling unit. Erosion can be monitored through the use of photography, nonpermanent measures, or the analysis of remotely sensed images. The amount of soil compaction resulting from human activity can be measured using a soil penetrometer. Data acquired using this instrument can be used as a surrogate measure of trampling intensity (see Cole 1987). Cole also examined the influence that three independent variables had on the area of vegetation loss. These variables include (1) amount of use, (2) vegetation fragility, and (3) the degree to which on-site traffic is concentrated. Monitoring data can be correlated with data concerning amount of use and the degree to which on-site traffic is concentrated to determine correlations concerning the source of human impacts. Data regarding vegetation fragility can also be used to determine the differential susceptibility of the plants being monitored.

Ecosystem Monitoring

Ecologists studying the flora and fauna of the *Colorado River Corridor* have identified the close interrelationships between the aquatic and riparian ecosystems of the Grand Canyon. For example, the riparian ecosystem in the Grand Canyon is extremely important to the nesting avifauna of the lowland Southwest and other wildlife in the region. In fact, the construction of Glen Canyon Dam caused an increase rather than a decrease in riparian vegetation and associated animal populations in the Grand Canyon. Biologists have recorded an increase in songbirds along the river.

Southern Paiutes are indigenous to the area including the Grand Canyon and perceive it as an integral part of their cultural landscape (see Stoffle et al. 1995). For example, their concern for plants reflects a concern for the Grand Canyon as a whole. Not surprisingly, any specific attempt to monitor culturally significant vegetation in the Grand Canyon must be related to other elements of their cultural landscape such as animals and sacred sites. One possible way of incorporating this holistic concern for the Grand Canyon into the monitoring program is by looking at changes occurring at the ecosystem level. Scientists monitor the "health" of ecosystems primarily by looking at biological diversity; perhaps the Paiutes can develop similar measures of ecosystem health.

Over the last 30 years, biological diversity has become a primary area of concern in natural resource and wildlife management. For many years, members of the scientific community measured the productivity of ecosystems by the amount of biomass they produced. Biomass is the weight of biological material produced in a given area. Recent studies have indicated that biological diversity plays a significant role in the stability and adaptability of biological systems (Norton 1987). Biological diversity can be measured at the individual, species, community (ecosystem), and regional (landscape) levels. It is species richness that is most mentioned in relation to the management of biological diversity. Species richness refers to the number of species encountered in a particular area. This is the strictest definition of diversity because it does not include any index other than sheer number of species.

Plants that are part of riparian environments serve as both indicators and processors of environmental conditions. Riparian plants respond to changes in temperature, soil, moisture, slope, aspect, and even human activity that are affecting specific places (Johnson 1991:181). In addition, vegetation consists of the principal autotrophs upon which most other organisms depend (Whitaker 1975). In other words, the health of a plant community is an indicator of the health of most of the other elements of an ecosystem. Not surprisingly, some scientists have suggested that plant community diversity provides an efficient single measure of overall biological diversity (Lesica 1993:70). However, Lesica indicates that this might exclude some habitats that are poor in plant species. Within a given ecozone, plant species richness can be used with or as a substitute for plant community diversity.

A project to monitor natural resources at Channel Islands National Park focused on species population dynamics (Davis 1983). This included abundance, distribution, age structure, reproduction rates, phenologies, etc. By gathering these types of data, the monitors were able to understand how and why populations of plants and animals fluctuate and what factors influence their survival or demise. Although such a system provides a wealth of information about changes occurring at the species level, it does not provide a holistic understanding of changes occurring at the ecosystem or regional level.

Lesica (1993; see also Magurran 1988) used Shannon's Index of Diversity to measure community diversity because it takes both species richness and evenness into account. Species evenness refers to the distribution of species within a given area. Shannon's Index of Diversity can be utilized to measure either plant species or community diversity. If plant communities will be used to measure changes occurring both to the plants themselves and the ecosystem as a whole, then the plant communities in the Grand Canyon must be identified. Once plant communities are characterized, they are easier to identify than individual species of plants and require less time in the field.

Payne and Bryant (1994:7) have created a list of required information to assess changes in biodiversity. These include (1) assessing the processes and patterns of presettlement vegetation, (2) inventorying the ages classes of trees and/or community diversity, (3) analyzing the existing extent of corridors connecting communities, (4) assessing various guild or indicator species, (5) determining the minimum viable populations, distribution, and desirable population level, and (6) quantifying habitat parameters. Guild species are those species from a group of species that share a need for common resources in the environment (Payne and Bryant 1994:6). Indicator species are those species with ecological tolerances so narrow that their abundance indicates certain environmental conditions (1994:6). Other considerations for managing biodiversity include assessing successional changes due to natural or human caused changes to the ecosystem, assessing potential ecosystem health indicators such as plant community diversity, and developing procedures for habitat monitoring at one of the four levels of biological organization (individual, species, ecosystem, regional).

In order to understand how certain plants species and/or communities are changing over time, there must be a conception of what they are like now. Initial surveys must accumulate baseline data about vegetation in the *Colorado River Corridor* in order to assess the existing condition of cultural significant plants. For the purposes of controlled comparisons, the SPC might also want to develop an "ideal site" that represents the vegetation under perfect conditions.

Rock Art

A series of procedures for recording rock art have been developed for Petroglyph National Monument that are applicable to other rock art sites and settings (Walt and Brayer 1994:48-50). General field methods for recording rock art have also been developed for the National Park Service as a whole (Loendorf, Olson, and Conner 1993). Both reports outline a number of procedures for developing field survey forms, survey methods, and methods for mapping, photographing, drawing, rubbing, and tracing rock art for the purposes of documentation. The management and preservation of rock art in Australia has also been the focus of some research, and a report, *Conserving Australian Rock Art* (Lambert 1989), discusses in detail potential natural and human impacts as well as techniques for mitigating these impacts. All three of these reports contain useful techniques for documenting and preserving rock art. The most pertinent methods for recording and monitoring rock art in the *Colorado River Corridor* are reviewed below. Effective monitoring will require a consistent and systematic research and implementation program.

Rock art can be recorded in the field using manual or automated methods (Walt and Brayer 1994). Non-invasive manual recording methods include drawing, tracing, and computer aided drawing using a digital camera. Automated methods include standard still photography, terrestrial photogrammetric techniques, and video photography. Systematic and reproducible procedures for these and other recording methods have been developed by many researchers (see Walter and Brayer 1994; Loendorf, Olsen, and Conner 1993; Lambert 1989; Hartley, Vawser, Smith, and Johnson 1993). The cost, labor, and time required for each of these methods must be evaluated in light of the resources available to the monitoring program.

Still photography provides the easiest and most cost effective technique for recording and monitoring change to rock art (Fletcher and Sanchez 1994). For example, photographs of rock art sites near Gosford, New South Wales and Flanders Island, northeastern Queensland in Australia are being used to monitor pictographs for pigment loss (Lambert 1989:59). Methodological concerns regarding photographs, such as lighting, film, camera, lenses, time of day, and vantage point, have been discussed in detail and are relevant to the documentation and monitoring of rock art sites (see Loendorf, Olsen, and Conner 1993; Walt and Brayer 1994; Hartley, Vawser, Smith, and Johnson 1993; Brewer and Berrier 1984; Cole 1989). If still photography is to be adopted as a method for documenting change to rock art sites, a reproducible and systematic protocol should be adopted before the monitoring begins. Ultimately, photographs should enhance and not replace field measurements that are the foundations of most monitoring programs (Cole 1989:4).

Close range photogrammetry is another technique that can be used for detailed recording of rock art. This technique uses stereo photos to produce a contour image of rock art. The advantage of this method is that the topographic setting of the site can be recorded for map production at levels of accuracy and speed that surpass other theodolite and tape procedures (Hartley, Vawser, Smith, and Johnson 1993:48). However, photogrammetric recording methods tend to be much more expensive and labor intensive than conventional photography.

Although Prince (1988) has developed a method for superimposing old photographs over current ones for the purpose of understanding changes to rock art sites, the digitization of photos would better serve both monitoring and archival purposes. Hartley, Vawser, Smith, and Johnson (1993:39) have mentioned that the digitization and rectification of photographic images holds great possibilities for analyzing and documenting rock art sites. Digital camera technology eliminates the need for film and does away with a step in the process toward digitization (Walt and Brayer 1994:27). However, digital cameras are quite expensive, approximately $10,000, and therefore are not necessarily cost effective for monitoring purposes. The digitization of photographs also requires both a high quality scanner and place to store the images, but this technology is considerably less expensive.

Once rock art images have been captured, the most effective means of database storage and analysis is digitization. Digital images should be stored in an industry standard format such as TIFF (Tagged Image File Format). Images can be catalogued using PC-DOS databases like Paradox and MS Access and stored in associated hard, CD-ROM, or tape drives. Digital image processing using computer software can also prove to be useful in analyzing change images for monitoring purposes.

No matter what recording technique is adopted, rock art can be most profitably examined and monitored in relation to its locational setting (Hartley, Vawser, Smith, and Johnson 1993:89). Identifying the geo-referenced location of rock art sites in the *Colorado River Corridor* can be accomplished through both conventional surveying techniques and the use of Global Positioning Systems (GPS). GPS units have been used at Petroglyph National Monument and Petrified Forest National Monument to identify the location of rock art sites with up to two meter horizontal accuracy. Accurate locational information is an important part of the monitoring process because it allows the distribution of rock art sites to be analyzed relative to natural features and processes (Walt and Brayer 1994:20). The spatial relationship of rock art sites to other elements of the natural and social environment can also be fruitful in interpreting cultural meaning. The association of a particular site with game migration trails is just one example (Fletcher and Sanchez 1994).

The report produced from the rock art demonstration project at Petroglyph National Monument suggests that ethnographic data be integrated with image and other text into one comprehensive database (Walt and Brayer 1994:51). This would require a computer system capable of handling multimedia operations as well as complex storage and query functions. The *Petroglyph National Monument Rapid Ethnographic Project* (Evans, Stoffle, and Pinel 1993) documents the concerns of Pueblo people that petroglyph protection through scientific documentation be achieved with equal attention to confidentiality and the protection of certain cultural knowledge about the petroglyphs. The SPC has plans to develop this type of database for tribal purposes (see **Multimedia Database**) and has expressed similar concerns that certain data remain confidential (Stoffle et al. 1995).

Traditional Cultural Properties

TCPs are often elements of a region's topography and therefore are imbedded within the Southern Paiute cultural landscape. Photographic documentation will prove to be particularly useful in monitoring these resources because aesthetic and visual interpretations of these landmarks reflect the cultural concerns of Southern Paiute people. The parameters for assessing impacts to TCPs must be determined through direct consultation with the SPC.

Animals

As described above, monitoring changes occurring to the entire ecosystem will help to better understand possible changes occurring to animals in the *Colorado River Corridor*. Studies concerned with changes to plant populations are more evident because plants are easier to see, count, and measure. Changes occurring to specific animal species can be monitored through a number of well documented techniques. Scientists interested in understanding changes occurring to specific animal species document known extent of habitat, population size, population density and other elements of population dynamics. Understanding changes to vegetation necessary for a particular species can also be an indicator of the health of a given animal population.

Other Considerations

Issues of sensitivity and privacy are extremely important when discussing the management of Southern Paiute cultural resources. Monitoring cultural resource sites of concern to Southern Paiute people must be conducted by Southern Paiute monitors. If there is even the possibility of the removal or displacement of archaeological or plant materials at culturally significant sites, traditional spiritual person(s) designated by the tribes will be called upon to bless the area and provide guidance (Stoffle, Halmo, Evans, and Austin 1994). The inclusion of such a person during monitoring trips is essential to the Southern Paiute monitoring process. The necessity for ceremonies at a given site should therefore be documented on the monitoring form. After each Southern Paiute monitoring trip, monitors must provide a written report of their findings to the governments of the Kaibab Paiute Tribe and Paiute Indian Tribe of Utah.

MULTIMEDIA DATABASE

The SPC has documented the cultural significance and use of a sample of Southern Paiute cultural resources in the *Colorado River Corridor*. As described in this chapter, certain concerns and recommendations that arose from these ethnographic investigations are being translated into parameters that can be monitored as part of the GCES-GIS. Issues relating to the sensitivity of these resources and educational concerns have prompted the SPC to begin developing a multimedia database of cultural resources in the *Colorado River Corridor*. Data that are collected by research activities funded by the GCES can be entered into both the GCES-GIS and the SPC's multimedia database. The development of a separate tribally run and operated database permits the SPC (1) to store and manipulate information about Southern Paiute cultural resources in a user-friendly database, (2) to monitor changes in these cultural resources with the help of GCES-GIS, and (3) to develop a multimedia tool for educational purposes.

Multimedia refers here to the integration of audio, video, and text on a personal computer. A multimedia database is ideal for storing and retrieving information regarding Southern Paiute cultural resources because inventories that have already been conducted include audio tape, still photos, video, and site specific textual data. Monitoring data, which will include both textual and visual data, can also be integrated into this database. This will allow the SPC to assess some of the changes occurring to Paiute resources in the *Colorado River Corridor*. The integration of these different media provides a holistic understanding of Southern Paiute cultural resources. In a sense, the multimedia database allows the user to "virtually" visit the *Colorado River Corridor*, from the perspective of Southern Paiute people. All involved Southern Paiute tribes will require both personal computers and trained personnel to monitor areas of concern using multimedia technology.

A SPC multimedia database would store all the information the SPC has accumulated regarding cultural resources in the *Colorado River Corridor*. It can also be expanded to include other associated cultural landscapes, like Kanab Creek and the Virgin River. A separate tribally operated database allows the SPC to manipulate and use the information it is helping to integrate into the GCES-GIS.

Data Transfer

The first step in developing a Southern Paiute multimedia database is to obtain relevant images and data from the GCES-GIS to provide a baseline of the natural resources in the *Colorado River Corridor* as well as a geographic context for data about Southern Paiute cultural resources. As these images are updated by the GCES, they can also be used to update the SPC multimedia database.

The images that would be of great interest to the SPC include (1) the entire *Colorado River Corridor* (1:24,000 USGS quads) and (2) aquatic, terrestrial, and sediment data for the entire *Colorado River Corridor* at 1:2,400 scale and larger. The SPC has to have the ability to receive and store these data. The cartographic and associated tabular data stored in an Arc/Info format at the GCES-GIS require very large digital storage capabilities. These data can be received either as digital tape (4mm,8mm or DAT) or via remote on-line access such as the Internet (i.e. The Information Superhighway). In the latter case, a storage device would still be required once the data had been transferred. In addition, the infrastructure needed to transfer data via the Internet does not exist on the Kaibab Paiute and Shivwits Reservations. Consequently, the SPC must acquire a digital tape device to access the GCES-GIS data.

The multimedia database should utilize an IBM-PC compatible computer that is running a recent version of DOS (currently DOS 6.22) and Windows (currently MS Windows 3.11 or Windows 95). This computer should also include the following hardware specifications:

* Pentium or RISC-based microprocessor (currently not available) running at 100 MHz or higher
* 17 or 21 inch monitor with high resolution and refresh rates
* 16 bit audio card with stereo speakers
* graphics accelerator (preferably with at least 2MB of VRAM)
* at least 32MB of RAM
* at least 1 GB hard drive with 256K cache
* a quad speed CD-ROM drive

The cost and specifications of two potential computer systems are described below.

For $4,900, Dell Computer Corporation sells a Pentium based processor running at 100MHz that includes Imagine 128 Graphics Accelerator with 4MB VRAM, 32MB RAM, quad speed CD ROM drive, 1GB hard drive with 256K cache, 17" Dell NI monitor with high resolution and refresh rates, one 3.5" diskette drive, MS DOS 6.2, MS Windows 3.1, and a microsoft mouse. A 16 bit audio card with speakers will cost an additional $200. For $4,600, Zeos International Ltd. markets a Pentium processor running at 100MHz that includes 32MB together around a common resource to collectively solve common problems. The SPC contributes to this monitoring process by identifying the location and size of areas of concern in the *Colorado River Corridor* and providing monitoring data about these areas to the GCES for integration into the GIS. The initial development and field testing of the SPC's monitoring program is described in Chapter Four.

CHAPTER FOUR

CULTURAL RESOURCES SURVEY AND MONITORING

This chapter presents some of the major findings from the initial efforts to develop and implement the Southern Paiute Consortium's (SPC) survey and monitoring program. These efforts included (1) program design, (2) coordination with surveyors from the Glen Canyon Environmental Studies (GCES), and (3) an eleven day raft trip along 225 miles of the Colorado River to begin program implementation. The SPC program has been developed to utilize a Geographic Information System (GIS) and an archival program, and to include both field and remotely sensed data (see Chapter Three).

This survey and monitoring program contributes to the SPC's efforts to collect information and participate in decisions that influence the use, management, and monitoring of traditional cultural resources located along the 255 mile Colorado River Corridor from Glen Canyon Dam to the end of the free-flowing river at Separation Canyon. This effort relied extensively upon results from studies conducted between 1992 and 1995. Those studies were documented in the other two reports of this series, *Piapaxa 'uipi (Big River Canyon)* (June 1994) and *Tumpituxwinap (Storied Rocks): Southern Paiute Rock Art in the Colorado River Corridor* (Draft, May 1995), and in Chapter Two of this report, "Ethnofauna."

METHODOLOGY

The survey and monitoring program outline was developed by two University of Arizona (UofA) ethnographers in consultation with the director of the SPC and a professional consulting botanist (see Chapter Three for program rationale). The surveying was conducted by a GCES survey team according to the standard GCES survey protocol developed in January 1991 (see Appendix E). One SPC monitor, a UofA ethnographer, the botanist, and four surveyors from the GCES began program implementation during the July 1995 raft trip through the *Colorado River Corridor*. The monitoring program was developed in three steps (see Chapter Three): (1) sites were selected for monitoring; (2) types of impacts and impact parameters were identified for each of the cultural resources at the sites; and (3) monitoring methods were identified and tested at the sites.

Choosing Monitoring Sites

Fifteen priority sites were identified for monitoring during 1995 (see Table 4.1). Information about each site was compiled from the ethnoarchaeology, rock art, ethnobotany, and ethnofaunal studies that had been conducted between 1992 and 1995 (see Chapter Three). One of the UofA ethnographers prepared a notebook, organized by monitoring site, that includes all information collected from Southern Paiutes about the sites. This notebook provides a quick site-by-site reference of cultural resources and Southern Paiute concerns at each site. Certain cuturally significant sites, such as Granite Park, were not included in the 1995 monitoring program because only a very restricted number of sites could be visited on the trip and places like Granite Park are already receiving special attention. Culturally significant sites not included in the current SPC survey and monitoring program may be added in the future.

Determining Types of Impacts and Impact Parameters

Aspects of each site requiring monitoring were identified and their location with respect to the Colorado River was noted (see Table 4.1). Both physical and spiritual impacts were considered for each site. Impact parameters were organized into categories of natural and human impacts. Examples of impacts are erosion, bank slumpage, spalling, trailing, and vandalism (see Chapter Three). A preliminary Cultural Resource Monitoring Form was developed for pretest and modification as part of the 1995 program. This form included both nonpermanent and permanent measures (see Chapter Three). This form included sections for recording general information about each cultural resource site and specific information about archaeological features (the "Archaeology Form"), rock art (the "Rock Art Form"), botany, (the "Plant Form"), and traditional cultural properties (the "Traditional Cultural Property Form"). No systematic animal monitoring was included in the initial development and field testing phase of the SPC program.

Selecting and Testing Monitoring Methods

Program field testing occurred during the survey and monitoring trip that began on July 5, 1995 at Lees Ferry and ended on July 15, 1995 at Diamond Creek. The purpose of the trip was to (1) permit SPC representatives to work with surveyors to begin to survey the exact boundaries of places and things of cultural significance, (2) permit SPC representatives to better understand the role of a GIS and of monitoring for protecting places and things potentially impacted by water released from Glen Canyon Dam, (3) provide an opportunity for SPC representatives and consultants to begin the development of a monitoring program, and (4) provide an opportunity for Southern Paiute youth to become familiar with their tribes' participation in the GCES and to observe how science and Southern Paiute traditional knowledge can contribute to improved management in the *Colorado River Corridor*. The description and results of the survey and monitoring program (purposes #1-3) are presented in this chapter. The description and results of the youth environmental education program (purpose #4) are presented in Chapter Five.

Table 4.1. Survey and Monitoring Stops

	Zone	Site: #1 - Jackass Canyon	#2 - South Canyon	#3 - Nanko weap	#4 - Lava/ Chuar	#5 - Tanner	#6 - Bed-rock Canyon	#7 - Deer Creek	#8 - Kanab Creek	#9 - Vulcan Com-plex	#10 - Whit-more	#11 - PrePar ashant	#12 - Ompi Cave	#13 - Spring Canyon	#14 - Indian Can-yon	#15 - Pump-kin Spring
Mi.		8L	32R	52R	65R	68L	130L	136R	143R	178RL	188R	198R	200R	204R	207R	213L
Day		1	2	3	4	4	5	5	6	7	8	9	9	10	10	10
AR	1				x											
	2			x	x		x		x		x	x			x	
	3		x	x				x	x	x				x	x	
RA	1															
	2					x						x				
	3		x					x		x	x			x		
PL	1	x		x			x			x	x			x		
	2	x		x			x		x	x	x	x	x	x		
	3			x				x	x					x		
AN			x	x				x			x					
TCP	1									x						x
	2															
	3												x			

AR=archaeology RA=rock art PL=plants AN=animals TCP=traditional cultural property

ZONES: 1=Within the New High Water Zone 2=Within the Old High Water Zone 3=Above the Old High Water Zone

At each monitoring stop, the SPC monitor, a Southern Paiute elder where possible, one UofA consultant, the botanist, and surveyors met to discuss the cultural resource monitoring site, identify the site boundaries, and determine an appropriate monitoring method. Both nonpermanent and permanent methods were used at each site. For example, photographs were taken at each site, and these were recorded in a photo log. Cultural resource locations were surveyed, monitoring forms completed, and, when necessary, plant transects or plots created and their boundaries recorded. At some sites, monitors identified transect and plant locations by environmental features such as boulders, and they will be able to locate them again using photos and data logs. At other sites, plant transects and plots were located by the surveyors and will require GCES surveyors for relocation. The advantages and disadvantages of tying the surveying to monitoring will be explored in future monitoring efforts. No efforts were made to create condition classes for the sites, but these can be created in the future, if desired.

GCES Survey Protocol

Surveying was carried out according to the GCES Control Survey Specifications developed in January 1991 (see Appendix E). Total stations were set up and leveled at each point. The height of the instrument, height of the rod and extensions, horizontal and vertical angles, temperature, and barometric pressure were recorded. Coordinates, elevation, description of the Total Station Benchmark, and azimuth direction or coordinates of the Backsight were also

Figure 4.1. A GCES surveyor and Total Station

recorded. Notes and information were recorded in pencil in a bound field book. For every survey point, identification of the site, mile marker, river bank, and a sketch map with a north arrow orientation were recorded. Information such as the date, time, weather conditions, and physical descriptions of the points was also recorded. Photo documentation of all sites was produced.

Conventional survey methods were supplemented by other approaches as needed to best utilize survey crew time and achieve as high an accuracy as possible. In areas where no reliable control points existed, such as remote areas or areas where difficult terrain make conventional survey methods inefficient, a Global Positioning System (GPS) was used. Two GPS control points were established for each feature location, the beginning of a traverse, or traverse closure.

Plant Monitoring Methodology

Nonpermanent measures for monitoring natural impacts to plants include qualitative assessments of the level of impact due to erosion, flooding, and animal foraging, and the presence or absence of river-based streams. Nonpermanent measures for monitoring human impacts included qualitative assessments of the level of impact from trampling, picking, or clearing of vegetation, and overall observations.

Photography was used as a permanent measure of impact at every site. In addition, several types of permanent, quantitative plant monitoring methods were installed at the various study sites where plant monitoring was deemed appropriate. The decision as to which method to utilize depended primarily upon the nature of the vegetation at the site. Secondary considerations included the time allotted to the site, availability of personnel, relocation potential, and the nature of the primary resource of concern present at the site. An important consideration was to test a number of different methods to see which of them would be most appropriate for SPC monitors who might not have a background in ecological sampling or plant identification. The value of these different methods will have to be tested through actual use by SPC monitors who will determine if these methods can effectively and accurately provide comparable data.

One of the primary considerations in installing permanent plant monitoring plots and transects is to be able to relocate them during subsequent monitoring trips. Photography is a very helpful tool, and photos were taken of each plant monitoring site installed on this trip. The details of original placement essential for exact relocation are best recorded by careful photography. This includes photographing end and corner points; photos of the route of transects over or under shrubs, trees, and rocks; general views so the site can be relocated; and photos at various places along the line for transects and from the corners in plots. Other photos of trails or cultural items along or within the sampling area were also taken.

The following vegetation sampling methods were used during the initial *Colorado River Corridor* monitoring trip in July 1995. These are generally standard vegetation measuring techniques, modified somewhat to simplify and hasten the data collection procedures. After gaining an overview of the site, the monitors decide upon a representative area in which plant monitoring should occur.

1. Belt Transect. This method works best with relatively open and sparse vegetation as is generally present on upper beach and desert areas. Generally the belt transect is laid perpendicular to the river with the 0 point at or near the river's edge. A metric tape is placed along the designated line. The total length can be variable, depending upon the area to be sampled; during the 1995 monitoring field test it did not exceed 70 m. Perennial plants are identified and counted in a 2 m wide belt to the right or left of the tape in 2 m long segments, giving counts of plants in a continuous series of 2 m x 2 m subplots. Only plants that are rooted within the subplots are included. Variations included sampling 1 m wide by 2 m long subplots, and sampling discontinuous 2 m x 2 m plots every 10 m along the transect. In the latter case, the areas between subplots were not sampled. From this data, frequency of occurrence is calculated from the number of subplots in which the plant occurs and abundance is calculated from the number of individuals counted.

2. Line intercept transect. This method works best when vegetation is fairly dense and when trees and large shrubs are mixed with grasses and forbs, as in a riparian zone. Placement and length of the line are selected as above. Plants intersecting an imaginary vertical plane above the line are said to "intercept" the transect, and the interval along the line in which the outer edges of the canopy occur is recorded for each individual plant. If plants overlap, they are recorded separately. The distance from the line at which they are rooted is not important as long as some part of the plant is above the line. The total accumulated length of intercept for each species divided by the total length of the transect gives a percent cover for that species (Mueller-Dombois and Ellenberg, 1974). Detailed documentation of the placement of the line with respect to plants intersected is essential to accuracy in re-reading the transect.

3. Plots with Selected Plants. This is a rapid method of establishing monitoring of individual plants, rather than a plant community. It was used when time was a factor, and when several culturally important species occurred together. At some sites, the plots that contained individuals of several culturally significant plant species were mapped by the survey team. Corners of the plot thus defined were also located by the surveyors for relocation purposes. All individuals of these species were recorded within the defined area, and height and width or height and number of stems were recorded, depending on the site. Other species occurring within the "plot" were not recorded. Data recorded at subsequent readings will give information on the survival of each individual and its growth as compared with previous readings. No ecological information on the community is obtained. Accurate re-reading depends on relocation of the same individuals, either through surveying, if available, or through accurate preparation of a field sketch of the site.

4. Individual Plant Monitoring. In a few cases the monitors wished to follow individual plants or a few significant plants at a site. The location of each plant was surveyed, and appropriate measurements of each individual were made. This is a plotless method similar to plots with selected plants.

Archaeology and Rock Art Monitoring Methodology

Sketch maps were drawn at all monitoring sites that include archaeology and rock art. Nonpermanent measures for monitoring natural impacts to archaeological sites include identifying the presence or absence of various types of erosion, gullying, bank slumpage, and river-based streams. At rock art sites, additional nonpermanent measures include identifying the presence or absence of salt deterioration, sediment impacts, and vegetation, microflora, or animal impacts.

Nonpermanent measures for monitoring human impacts to archaeology sites include identifying the presence or absence of rock piles, trailing, on-site camping, and vandalism, and the relationship of human impacts to dam operations. At rock art sites, nonpermanent measures include identifying the presence or absence of vandalism/graffiti, dust cover caused by foot traffic, erosion caused by trailing, the relationship of physical impacts to dam operations, and assessing the level of human access to the rock art panels.

Photography is the only permanent measure used at archaeological and rock art sites. Extensive photodocumentation provides a measure against which the nonpermanent measures can be appraised.

Traditional Cultural Property Monitoring Methodology

Nonpermanent measures for monitoring impacts to TCPs include assessing the overall condition of the TCP and of specific resources, such as the red paint at the *Ompi* Cave, where appropriate. Photography was used at all TCPs as a permanent measure of impact.

OVERVIEW OF FIELD TESTING

The initial design and field testing of the SPC monitoring program was accomplished during 1995. The river trip began on the morning of July 5, 1995 at Lees Ferry and continued until the morning of July 15, 1995 (see Table 4.2). Monitoring program development was begun at fourteen of the fifteen sites that had been identified during project design. Twelve of the fifteen sites were surveyed.

The survey and monitoring program accomplished all of its primary goals during this trip while leaving some important tasks for future efforts. GCES professional surveyors traveled with SPC representatives to see if the various cultural concerns identified in previous studies could be tied into the GCES survey system. Initial conclusions are that a potentially positive match exists between the Southern Paiute desires to protect these cultural resources and the survey system set up as part of the GCES-GIS. A sample topographic map, developed by the GCES Survey Department to illustrate the incorporation of Southern Paiute data with geographic information, has been included in Appendix F. The results of the 1995 monitoring efforts are divided into three areas: (1) surveying, (2) tying surveying to monitoring, and (3) testing monitoring methods. Each of these is briefly reviewed in the following sections.

Table 4.2. Schedule of Survey and Monitoring Activities

July 5, 1995	Depart Lees Ferry	Mile 0
	Lunch, Orientation Meeting	Mile 3
	Survey Stop #1 - Jackass Canyon	Mile 8
	Camp #1 - Jackass Canyon	Mile 8
July 6, 1995	Survey Stop #2 - South Canyon	Mile 31
	Lunch - South Canyon	Mile 31
	Camp #2 - Nankoweap Canyon	Mile 52
July 7, 1995	Survey Stop #3 - Nankoweap Canyon	Mile 52
	Lunch - Nankoweap Canyon	Mile 52
	Stop - Little Colorado River	Mile 61.5
	Survey Stop #4 - Lava Canyon	Mile 65
	Camp #3 - Tanner	Mile 68
July 8, 1995	Survey Stop #5 - Tanner	Mile 68
	Lunch - Phantom Ranch	Mile 88
	Camp #4 - Bass Camp	Mile 107.5
July 9, 1995	Survey Stop #6 - Bedrock Canyon	Mile 130
	Lunch - Across from Deer Creek	Mile 136
	Survey Stop #7 - Deer Creek	Mile 136
	Camp #5 - Pancho's Kitchen	Mile 137
July 10, 1995	Survey Stop #7 (cont.) Deer Creek	Mile 136
	Lunch - Pancho's Kitchen	Mile 137
	Survey Stop #8 - Kanab Creek - No survey; monitoring only	Mile 143
	Camp #6 - above Olo Canyon	Mile 145
July 11, 1995	Lunch - Vulcan's Anvil	Mile 178
	Survey Stop #9 - upper Vulcan's Anvil Complex	Mile 178
	Camp #7 - Vulcan's Anvil	Mile 178
July 12, 1995	Survey Stop #9 (cont.) - lower Vulcan's Anvil Complex	Mile 178
	Lunch - below Lava Falls	Mile 180
	Survey Stop #10 - Whitmore Wash	Mile 188
	Camp #8 - Whitmore Wash	Mile 188
July 13, 1995	Survey Stop #11 - above Parashant Wash	Mile 198
	Lunch - above Parashant Wash	Mile 198
	Survey Stop #12 - Hematite Cave- No survey; monitoring from below	Mile 200
	Camp #9 - below Hematite Cave	Mile 201
July 14, 1995	Survey Stop #13 - Spring Canyon	Mile 205
	Lunch - Spring Canyon	Mile 205
	Survey Stop #15 - Pumpkin Spring	Mile 213
	Camp #10 - 224 Mile Canyon	Mile 224
July 15, 1995	Take Out - Diamond Creek	Mile 225

Surveying

Key issues that were faced in surveying include (1) would existing cultural resources be in line-of-sight from existing control points or would a series of new survey points be required to bring the Paiute places into the GCES survey system, and (2) when GCES lacked control points at certain locations would time be available to survey cultural resources? In general, proposed Southern Paiute monitoring sites presented a wide variety of survey problems, most of which were solved during the trip. Other sites will require GCES surveyors to return and set control points so the sites can be placed in the GCES-GIS.

Southern Paiute cultural resources are distributed and bounded in very different ways; thus, they must be placed in the GCES GIS in different ways. Traditional use plants, for example, may exist as homogeneous fields of Indian rice grass *(Oryzopsis hymenoides)* growing across a large sand dune or they may consist of three small and isolated plants of purple sage *(Salvia dorrii)*. It was necessary to try different survey techniques to accommodate the specific needs at each site. In most cases, the actual boundary of the cultural resource was not surveyed; instead, places within the cultural resource sites to be monitored were surveyed. This created quite different survey to cultural resource relationships. The narrow canyon entrance to Deer Creek was surveyed in detail so that an accurate map of all "hand prints" pictographs can be compared against the actual shape of the canyon. At Jackass Canyon, on the other hand, only the location of a plant transect was surveyed.

Tying Survey to Monitoring

In addition to the time and the resources necessary for mapping and surveying cultural resources, the SPC monitoring program requires that young Southern Paiutes be able to return to these locations at future dates and evaluate changes in the conditions of cultural resources. For this monitoring to occur it is necessary that Paiute monitors (1) be able to find the exact boundaries of the surveyed cultural resources, and (2) be able to evaluate in some systematic way what has or has not happened to these resources since the last monitoring trip. In general, it was possible to photograph and map all survey points. However, some places cannot be found again without the assistance of GCES surveyors. Also, the professional botanist helped set up different types of plant monitoring systems, but accuracy will require knowing exact survey locations, identifying plants, and understanding the plant monitoring methodology. Elsewhere, reasonably accurate maps and photographs will permit Southern Paiute monitors to easily and accurately assess cultural resource impacts.

Testing Monitoring Methods

Two UofA ethnographers, in consultation with GCES, Grand Canyon archaeologists, professional botanists, and the SPC, prepared a first version of a field monitoring book. This book had specially prepared procedures and questions for plants, archaeology, rock art, and traditional cultural properties (TCPs). For each Southern Paiute monitoring site, certain of these cultural resources were to be monitored using these proposed monitoring forms.

Prior to the field testing, a baseline existed for each monitoring site. Past Southern Paiute studies established this baseline so that the conditions of each type of cultural resource were known before it was selected to be surveyed and monitored during the 1995 trip. In general, the forms were useful for recording what was to be monitored. Some changes were recommended, and these can become a part of the next version of the monitoring form. An unplanned but valuable benefit of the field testing phase was that monitoring information was gained from direct observation at each site. For example, at some places damage has occurred since the Southern Paiute studies occurred, and at other places plants have recovered and are in better condition than they were when initially studied.

The overall monitoring process, including data collection and analysis, is manageable and provides information that is both usable and useful. The monitoring books are easily handled and contain enough information to fully characterize the conditions of each cultural resource site. The text, quantitative data, and photo logs combine to create a well organized and readily accessible record of site conditions.

SITE-BY-SITE DISCUSSIONS

The 1995 field testing established the SPC monitoring program. Detailed information about each cultural resource site is contained in the monitoring books stored at the SPC and UofA. The purpose of this section is to briefly describe the findings at each site and recommendations for revisions to the monitoring program or for actions to be taken by management agencies regarding the site. A variety of methods were used at the selected monitoring sites. At many sites, in addition to an overall site assessment, information was collected about specific plants, archaeological features, rock art panels, or TCPs. The following summaries include (1) a very brief introduction to the site including the status of survey control there (see Stoffle, Halmo, Evans, and Austin 1994 and Stoffle et al. 1995 for more detailed site descriptions), (2) discussion of the particular features that were monitored, (3) future monitoring considerations, and (4) recommendations.

Survey Stop #1 - Jackass Canyon (Mile 8 L)

This site encompasses a large beach area that is used by both river runners and hikers who access the site by a steep trail down Jackass Canyon. Most of the hikers are fishermen, some of whom are day hikers and others of whom camp on the beach. For a beach below Lees Ferry, the site is unusually heavily impacted by charcoal and trash. The upstream part of the beach, near the outlet of Jackass Creek, is higher, has rocks and boulders embedded in the sand that make it less desirable for camping, and is apparently less used by recreationists. Surveyors established control at this site.

Plants

The upstream part of the beach has a dense stand of Indian ricegrass (*Oryzopsis hymenoides*), and a line of netleaf hackberries (*Celtis reticulata*) is present at the lower edge of the talus, probably representing the Old High Water Zone (OHWZ). Diversity of desert species (grass, herbaceous perennial plants, cacti, and small shrubs) is fairly high on undisturbed portions of the beach. The area was last partially inundated by high water in 1983, and Jackass Creek eroded its banks and deepened its channel during a period of flooding and mudflow in early 1994. Human impacts on plants on the upper beach are minimal. There are a few broken branches of hackberries along the trail passing by them; however, this is balanced by a high level of reproduction as evidenced by many young hackberry plants.

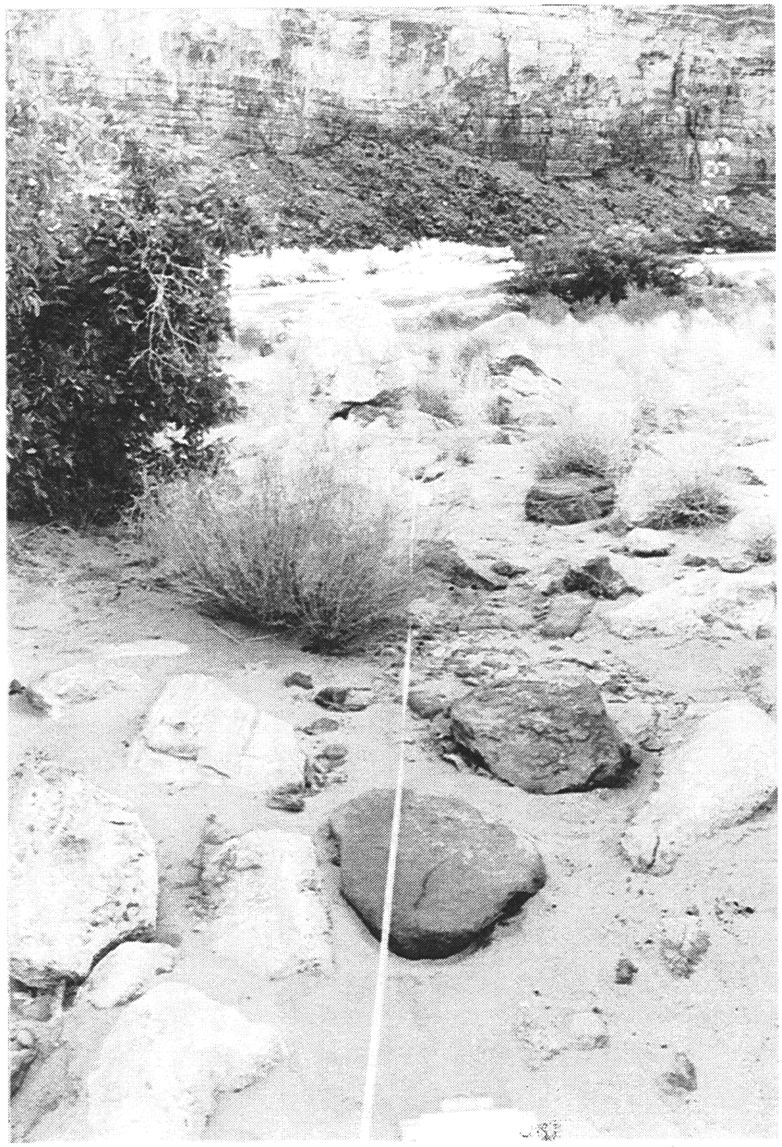


Figure 4.2. Plant transect at Jackass Canyon looking along meter tape from ca. 55 m to 0 point at river

One plant transect was installed in the upstream part of the beach at Jackass Canyon, in the portion of the beach away from the area heavily impacted by camping. The transect is 66.85 m in length, and it runs from the top of a large white boulder at the Colorado River shoreline to a striped red rock at the upper part of the beach at the base of the talus slope. It passes from the lower beach area with young coyote willows (*Salix exigua*) through a high dune area with abundant Indian ricegrass to the back of the delta with an intermittent line of hackberry. The transect was established with discontinuous 2 m x 2 m subplots located every 10 m along the line beginning at the 8 m point, *ie*, from 8-10 m, 18-20 m, etc. Subplots were placed on the right-hand side of the tape, as viewed from the 0 point. Surveyors located transect line endpoints and used the information to stake out intermediate points. All plants within the plots were identified and counted. Data from the transect is summarized in Table 4.3. The Relative Importance (RI) of each plant in the transect is calculated by dividing the total number of each type of plant within all quadrats by the total number of all plants within all quadrats. The frequency (Freq.) of the plant species is calculated by dividing the number of quadrats that contain even one plant of that species by 6, the total number of quadrats.

Table 4.3. Plants in Six Quadrats at Jackass Canyon

	Number of Plants								
Plant Name	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Total**	**RI**	Freq.
Dicoria brandegei (Single fruit dicoria)	0	0	0	0	4	0	4	9.3%	16.7%
Oryzopsis hymenoides (Indian ricegrass)	1	0	18	4	1	0	24	55.8%	66.7%
Salsola iberica (Russian thistle)	0	0	0	1	1	0	2	4.7%	33.3%
Stephanomeria exigua (Wire lettuce)	0	0	4	6	0	0	10	23.3%	33.3%
Tessaria sericea (Arrowweed)	1	2	0	0	0	0	3	7.0%	33.3%
Total	2	2	22	11	6	0	43	100.0%	83.3%

Notes: Trail passes through Quadrat 6.
A hackberry (*Celtis reticulata*) is located 2 m to the right of the line between 44.5 and 48.0 m.
A snakeweed (*Gutierrezia microcephala*) is located to the right of the line between 47.0 and 47.5 m.

Future Monitoring Considerations

General observations of the encroachment of the impacted area on the upstream part of the beach should be made. Establishment of campsites and new trails should be noted. Condition of ricegrass, which is the most abundant plant on most of the upper dune, is a good subjective indicator of overall condition. Photos are available of transect endpoints and of subplots along the transect.

RAM, quad speed CD ROM drive, Diamond Stealth graphics accelerator with 2MB VRAM, 17" Zeos SVGA NI monitor with high resolution and refresh rates, one 3.5" diskette drive, microsoft mouse, MS DOS 6.2, MS Windows 3.1, and a 16 bit sound card with stereo speakers.

In addition, the SPC should purchase a tape or cartridge drive for storage and database access and a flat screen scanner for digitizing photographs. A 4mm or 8mm tape backup drive will cost between $1,000 and $1,500 while a high quality scanner will cost between $500 and $1,000.

A software package such as Director 4 or Tool Box will also have to be purchased in order to create a user-friendly Graphical User Interface (GUI) from which all types of cultural resource data (textual, graphical, and audio) can be accessed and manipulated. This type of "authoring software" ranges in price from $200 to $1,000. It is also recommended that the SPC purchase an image editing software program such as Adobe Photoshop as well as a user friendly PC based GIS tool such as PC Arv/View 2.0. Many high quality scanners are packaged with Adobe Photoshop so this software will probably not have to be purchased separately. PC Arc/View is currently priced at around $900. This program would allow the SPC to easily view and analyze GIS related images that they receive from the GCES.

One of the features of the multimedia database will be its expandability. Data from outside the affected zone will be included in the database. Areas where other ethnographic inventories have and will be conducted will provide comparable data that can be added when time and resources become available.

Education and Multimedia

One of the prime purposes for the development of a multimedia database is to store information about Southern Paiute culture, including information about the Southern Paiute mythology and language and the Southern Paiute cultural landscape. A key reason for storing this type of information is its value in education. Cultural knowledge about plants, animals, and the natural environment can be imparted to Southern Paiute youth through the use of sound, text, and pictures. The incorporation of this computer database into the school curriculum of Southern Paiute children would prove invaluable in teaching them about their rich living heritage. It will it provide them with both a source of knowledge about their culture and also practical experience with computers. The use of audio, video, and text allows a wide variety of people, who have previously been unable to visit the Grand Canyon, to learn about how the Southern Paiute people are connected to the Colorado River and the beautiful canyon it has formed.

CONCLUSION

The incorporation of the SPC's concerns into the GCES-GIS long range monitoring plan contributes to a comprehensive understanding of how cultural resources in the *Colorado River Corridor* are being impacted over time. GIS provides one mechanism by which people in different organizations, different levels of government, and different disciplines can come together around a common resource to collectively solve common problems. The SPC contributes to this monitoring process by identifying the location and size of areas of concern in the *Colorado River Corridor* and providing monitoring data about these areas to the GCES for integration into the GIS. The initial development and field testing of the SPC's monitoring program is described in Chapter Four.

Recommendations

This site should be monitored annually to assess the expansion of the heavily impacted camping area. It is probably not necessary to re-read the transect every year unless human impacts on the upstream part of the beach are noted. This is a plant monitoring site with no other cultural elements present.

Survey Stop #2 - South Canyon (Mile 31 R)

This site contains several elements of archaeological interest and is upstream of the mouth of South Canyon on a bench at the top of a low Redwall cliff. The site is well known to river runners, and raft parties frequently visit it. Soils are generally sandy and unstable on the steep slope, and vegetation is sparse. Surveyors occupied previously established control at this site. No plant monitoring transects or plots were installed here.

Archaeology and Rock Art

This site contains both archaeological features and rock art, including rock houses, grinding areas, a rock art boulder, and a burial place. These areas have been recorded as three separate archaeological loci. The three archaeological loci were located by the surveyors and monitored. Information about these places, including the rock art boulder, was recorded on three Archaeology Forms. Visual analyses, photographs, written notes, and audio tape recording were used to record information at all three loci. The first locus includes 2 rock houses. There were no natural impacts observed, but there were human impacts to the site since the last monitoring. Therefore, human impact was the main concern of monitoring this particular site. The impacts include loss of surface pottery and stone chips and heavy trailing. The trailing indicates heavy use by tourists and is possibly why there seem to be rocks falling from the rock houses.

Locus #2 consists of three grinding areas, and a rock art boulder. This is where the rock art monitoring was recorded on an Archaeology Form. No natural impact was discovered here. The impacts were caused by humans and include possible camping upstream of the site, what appears to be a new age ceremonial pile containing sherds and calcite crystals placed between the grinding areas and the rock art boulder, and a rock that has been placed in one of the grinding areas since last monitoring (May 1995).

Locus #3 consists of a burial place where a human skeletal remains were found. Natural impacts include surface and eolian (wind) erosion. Human impacts are many. Below the ridge, the beaches next to the river seem to be vanishing due the fluctuating water from the dam. This enables campers to camp on top of the ridge where the sites are located. There is trailing through the site, and a main trail has been created above the site parallel to the river.

Future Monitoring Considerations

Photographs and written notes taken at this site provide a good basis for the Southern Paiute monitoring program. In addition, photographs of the pots that were removed from this site have been obtained from the National Park Service. Complete information about what has happened to the burial remains is needed.

Figure 4.3. Rock houses at Survey Stop #2

Recommendations

These three loci should continue to be monitored each year due to the significance of the burial site and the heavy tourist use. At one locus (#2), an elder from the Shivwits tribe identified three holes as grinding mortars. These should be visited and recorded on the next trip. In addition, the new age ceremonial pile collection should be monitored. The SPC recommends that the trailing through Locus #3 be reduced by an activity, such as planting cacti around the burial, so people will not continue to walk over the burial site.

Survey Stop #3 - Nankoweap (Mile 52 R)

The monitoring site at Nankoweap encompasses a large area and was not rigidly defined. Elements included in the monitoring survey included the old mudflow ridge immediately downstream from Nankoweap Creek, the Colorado River shoreline at the mouth of Nankoweap Creek, and the floodplain of the creek for a distance of about 300 m upstream from the river. The New High Water Zone (NHWZ) along the river is unstable and has recently been affected by a flash flood in Nankoweap Creek. A steep bank marks the limit of erosion by the flood and also separates the NHWZ from the OHWZ. The floor of the creek was widened by the flash flood and plants were washed away. The mudflow ridge contains a large archaeological site which is frequently visited by raft parties and less often by hikers; there is a trail system from the creek, through the site to the base of the steep talus slope connecting with the trail to the granaries present high on the Redwall cliff at the site, then leading downstream to the main camping beach. Surveyors occupied previously established control at this site.

Plants

The mudflow ridge has a well-developed desert plant community and is especially dominated by large patches of Englemann prickly pear cactus *(Opuntia phaeacantha)*. Cactus patches grow on parts of the archaeological site, and the trail winds its way between cacti. Some riparian vegetation was lost along the river in the flash flood, and recovery is just beginning with a few cattails *(Typha latifolia)* at the shoreline and patches of smooth scouring rush *(Equisetum laevigatum)* along the creek. Three cottonwoods *(Populus fremontii)* on the floor of the creek survived the flood, and the site where a plot was established is above the creek bed and was not affected. Unless another flood occurs, recovery of vegetation along the creek can be anticipated, perhaps at a rapid rate.

Three plant monitoring elements were established at Nankoweap, all located along Nankoweap Creek. A 50-m long segmented belt transect 2 m wide was placed at the mouth of the creek, running from 0 m at the Colorado River shoreline across the NHWZ and along the south bank of the creek to 50 m at the lower edge of the OHWZ. The belt was placed on the right-hand (upstream) side of the transect. In the lower 31 m of this transect, below the bank cut by the flash flood, plant intercept intervals and counts were recorded within the belt. These were converted to 2 m long subplots in analyzing the data. Above the bank, where vegetation was denser and undisturbed by the flood, counts of individual plants within 2 m x 2 m subplots were made. Photos were taken at the 0 and 50 m points, and at 10 m intervals along the transect. Surveyors located transect line endpoints. Early recovery of riparian and lower beach plants was noted in the scoured zone, while the upper area was a stable community of grasses and shrubs typical of the upper beach zone. Results of the belt transect are summarized in Table 4.4. The relative abundance of each plant species is calculated by dividing the total number of plants of that species by the total number of all plants in the transect. The relative frequency of each plant species is calculated by dividing the number of cells in which the species occurs by the total number of cells in the transect. Finally, the importance value is calculated by adding the abundance and frequency and dividing by two.

Table 4.4. Vegetation Monitoring in Segmented Belt Transects at Nankoweap Creek

Plant Name	Total	Relative Abundance	# Cells	Relative Frequency	Imp. Value
Acacia greggii (Catclaw acacia)	3	1.5%	3	12.0%	6.7%
Aristida purpurea (Purple three-awn)	27	13.4%	7	28.0%	20.7%
Artemisia ludoviciana (Water sage)	3	1.5%	1	4.0%	2.7%
Baccharis emoryi (Emory seepwillow)	1	0.5%	1	4.0%	2.2%
Brickellia longifolia (Brickell bush)	19	9.5%	5	20.0%	14.7%
Cynodon dactylon (Bermuda grass)	13	6.5%	2	8.0%	7.2%
Dyssodia pentachaeta (Dogweed)	8	4.0%	3	12.0%	8.0%
Ephedra torreyana (Torrye Indian tea)	1	0.5%	1	4.0%	2.2%
Equisetum laevigatum (Scouring rush)	46	22.9%	8	32.0%	27.4%
Erioneuron pulchellum (Fluff grass)	2	1.0%	1	4.0%	2.4%
Gutierrezia microcephala (Snakeweed)	15	7.5%	7	28.0%	17.7%
Opuntia erinacea (Grizzly bear prickly pear)	1	0.5%	1	4.0%	2.2%
Salix exigua (Coyote willow)	2	1.0%	2	8.0%	4.2%
Sporobolus cryptandrus (Sand dropseed)	10	5.0%	3	12.0%	8.5%
Sporobolus giganteus (Giant dropseed)	10	5.0%	5	20.0%	12.5%
Stephanomeria exigua (Wire lettuce)	14	7.0%	7	28.0%	17.5%
Tamarix chinensis (Tamarisk)	5	2.5%	4	16.0%	9.2%
Typha latifolia (Cattail)	21	10.4%	1	4.0%	7.2%
Total	201	100.0%	25		

Note: A catclaw is located 2.65 m off the line at 35 m.
The edge of the bank is 3.10 m off the line at 35 m.
Indian tea (*Ephedra viridis*) is 3.5 m beyond the 50 m endpoint and 1 m left of the line.
Mesquite (*Prosopis glandulosa* var. *torreyana*) is 2.5 m toward the bank at 40 m.
Rabbitbrush (*Chrysothamnus nauseosus*) is 1.1 m beyond the 50 m endpoint on the line.

A plot with selected plants was established on the north side of Nankoweap Creek approximately 100 m upstream from the 50 m end of the transect. This site is at the place where Southern Paiute elders conducted plant interviews on the ethnobotany river trip in May, 1993. Eleven individual plants of nine species were selected for monitoring. Each monitored plant was located by the surveyors and mapped by hand by the monitors. Measurements of height and greatest diameter were made. Data from the plot are presented in Table 4.5. Evidence of human trampling was noted on a four-wing saltbush (*Atriplex canescens*) included in the monitoring and a large patch of banana yucca *(Yucca baccata)* which was mostly alive in 1993 but has now largely died out from undetermined causes. One rosette on the upstream side of the patch and six rosettes on the downstream side remain alive. Photos of each plant were taken. Table 4.5. summarizes data from the plot.

Figure 4.4. Banana yucca in selected plants plot along Nankoweap Creek

Three individual cottonwood trees a short distance upstream along Nankoweap Creek from the plot were selected for individual plant monitoring and are included in Table 4.5. These were located by the surveyors, and their heights were measured. These trees pre-date the recent Nankoweap Creek flood, and the lower portion of two of them had bark removed by the flood; their survival is in doubt.

Future Monitoring Considerations

Relocation of the transect should start at the 50 m end; the end at the river was placed in a clone of cattails and had no definitive endpoint. Its position with respect to the shoreline will depend upon water level at the time of re-reading. Recovery of plants in the riparian zone will be of most interest here. The upper part of the transect, above the bank of Nankoweap Creek, is in a relatively stable plant community but could be lost in another flash flood in Nankoweap Creek. The bank, 1.5-2.5 m from the transect, is steep and unstable and could further erode.

The selected plants plot is probably safe from moderate floods in Nankoweap Creek. These size of these plants can be compared between monitoring trips, and further dieback or

Table 4.5. Vegetation Monitoring of Selected Plants at Nankoweap Creek

Plant Number	Plant Name	Height at Tallest Point	Width at Widest Point
IPM1	*Populus fremontii* (Cottonwood)	3.3 m	-
IPM2	*Populus fremontii* (Cottonwood)	6.0 m	-
IPM3	*Populus fremontii* (Cottonwood)	6.7 m	-
1	*Acacia greggii* (Catclaw acacia)	1.20 m	2.10 m
2	*Atriplex canescens* (Four-wing saltbush)	0.65 m	1.10 m
3	*Ephedra viridis* (Indian tea)	1.08 m	1.90 m
4	*Encelia farinosa* (Brittlebush)	0.40 m	0.65 m
5	*Atriplex canescens* (Four-wing saltbush)	0.90 m	1.50 m
6	*Fallugia paradoxa* (Apache plume)	1.30 m	2.10 m
7	*Yucca baccata* (Banana yucca)	1.20 m	2.10 m
8	*Chrysothamnus nauseosus* (Rabbitbrush)	0.90 m	0.65 m
9	*Chrysothamnus nauseosus* (Rabbitbrush)	0.60 m	1.05 m
10	*Echinocereus engelmannii* (Engelmann hedgehog)	0.25 m	0.45 m
11	*Prosopis glandulosa* var. *torreyana* (Torrey mesquite)	2.65 m	2.5 m

regeneration of the banana yucca patch should be followed. The cottonwoods in the stream bed should be followed to see if they recover from the loss of bark during the last flood. Although the precise relocation of these plants would probably require surveyors, most of them could probably be found using the sketch map and photos.

Recommendations

Due to time constraints, no plant monitoring sites were established on the mudflow ridge; this should be done on a future monitoring trip. Belt transects could be installed in the area of archaeological features, and plots with selected plants might be combined with selected cultural features to establish a plot with both cultural and botanical elements. Frequent monitoring at Nankoweap would be desirable due to anticipated changes in the riparian zone and potential impacts due to high levels of visitation. The archaeological features present at Nankoweap were not surveyed or monitored due to lack of time at the site. These should be incorporated into the monitoring program in the future.

Survey Stop #4 - Lava Canyon - Chuar (Mile 65 R)

The archaeological site at this stop is in the upper portion of the beach, mostly within the OHWZ. Flooding and trailing have caused the site to erode, and the National Park Service (NPS) has closed the site to visitation. Dense growth of old catclaw acacia *(Acacia greggii)* and Torrey mesquite *(Prosopis glandulosa* var. *torreyana)* covers much of the site and adjacent upper beach. Notable plants on a steep shale slope across Lava Canyon from the site include three individuals of purple sage *(Salvia dorrii),* a culturally significant species that was not otherwise encountered in any monitoring program established during this trip. No surveying was done at this site, although survey control was established at this site prior to this trip.

Figure 4.5. Erosion at Lava Canyon - Chuar

Archaeology

The archaeological features at this site include roasters, hearths, and charcoal. One Archaeological Form was filled out. Visual analyses, photographs, written notes, and audio tape recording were used to record information. Photographs were concentrated on the eroded bank located in the wash. There were lots of natural impacts observed, including surface erosion, gullying, arroyo cutting, bank slumpage, eolian/alluvial erosion, side canyon erosion, and flooding which caused all this erosion. There was no observed human impact, except former on-site camping that occurred nearby. The camping intensified the erosion at the site, so the NPS closed it to visitors.

Future Monitoring Considerations

Photographs and written notes taken at this site provide a good basis for the Southern Paiute monitoring program.

Recommendations

The site should be monitored every year for surface and side canyon erosion, gullying and bank slumpage. Future monitoring should include a series of transects down the wash to the mouth of the river to measure the extent of the erosion (see Survey Stop #13 - Spring Canyon for an example of this type of monitoring). Purple sage plants along the downstream bank of Lava Canyon could be monitored as individual plants. This site must be surveyed in the future.

Survey Stop #5 - Tanner Camp (Mile 68 R)

The beach at this site is very large and includes dunes overlying a large cobble-gravel bar along the Colorado River. The monitoring site is at the downstream edge of the beach, on a narrow rocky ridge above a small side canyon. The ridge consists of displaced boulders embedded in the remnants of an old debris flow, cemented in place by travertine. Rock art features are etched in a desert varnish patina on the flat surfaces of large sandstone boulders, probably from the Dox formation. There are few plants on the ridge; trampling was noted in at least one individual of brittlebush *(Encelia farinosa)* located along a trail. Surveyors occupied previously established control at this site.

Rock Art

This site includes six boulders containing rock art and varnish. One Rock Art Form was filled out. Visual analyses, photographs, and written notes were used to record information. The six boulders were located by the surveyors, and information about them was recorded. The observed natural impacts to the site include surface erosion due to rainfall and possible frost damage. There are soil, dirt, and mud impacting the rock art. Among the human impacts are the heavy erosion caused by trailing near the boulders, trampling of vegetation in the vicinity, and places where the rock art panels are being buried by erosion from above caused by tourists walking near the boulders. The trails that lead to the boulders are steep and unstable, so erosion will continue to occur and may cause the boulders to topple.

Future Monitoring Considerations

Photographs and written notes taken at this site provide a good basis for the Southern Paiute monitoring program.

Recommendations

Extensive trail work is needed at this site to establish trails that are less susceptible to erosion. There is also a possible grinding slab by rock #4 that requires further investigation. Southern Paiutes need to visit this site regularly to offer prayers.

Survey Stop #6 - Bedrock Canyon (Mile 130 L)

This site consists of a ceremonial site on a low terrace above the creek and a large fire pit on an upper terrace at the OHWZ. A ten-foot high sand bank separates the two sites, and an unstable trail passes up the bank. Recent flooding along the creek has caused some scouring and created unstable banks. Much of the sand on the upper beach, including that which fills the fire pit, is probably wind-blown. Surveyors established new control at this site.

Plants

Four plants along the bank separating the two archaeological elements were selected for individual monitoring and located by the surveyors. These included two Nevada Indian-tea *(Ephedra nevadensis)*, one catclaw acacia *(Acacia greggii)*, and one California barrel cactus *(Ferocactus acanthodes)*. All of these plants appear to be potentially vulnerable to erosion of the sand bank or by flash flooding along the creek.

Archaeology

At this site, one Archaeology Form was completed. Visual analyses, photographs, and written notes were used to record information. The site has been interpreted as a possible women's healing site (see Stoffle, Evans, Halmo, and Austin 1994), so the fire pit and rock ring were located by the surveyors and information about them recorded. Natural impacts observed at the site include surface erosion over the roaster and middens, arroyo cutting along one edge of the rock ring threatening the structure and the middens, and bank slumpage near both structures causing the wash to widen. Erosion is especially troublesome at this site because the washes have developed into river-based streams. Human impacts include the dam's influence on sediments within the river channel encouraging the formation of river-based streams and trailing around the fire pit and leading from the rock ring up the bank to the fire pit.

Future Monitoring Considerations

Photographs and written notes taken at this site provide a good basis for the Southern Paiute monitoring program. In addition, the SPC's video recording taken in July 1992 can be viewed to identify changes that have occurred since that time. The status of the individual plants selected for monitoring will serve as an indication of erosion along the bank.

Recommendations

This site should continue to be monitored in the future with particular attention paid to the wash and the trails. It should be considered for possible work, in consultation with the tribes, to slow or divert the wash erosion. Trails leading to the site should be blocked to protect the features.

Survey Stop #7 - Deer Creek (Mile 136 R)

Deer Creek is a large, complex site with a number of elements present. Above Deer Creek falls is a narrow chasm about 800 feet long; this chasm has a trail which is heavily used both by rafting parties and hikers. Along this trail are a number of pictographs which are the central focus of an intensive monitoring program. Upstream from the chasm, the canyon abruptly widens into a broad, open valley with Deer Creek forming a narrow riparian strip along the valley floor. This portion of the valley has been subjected to periodic flooding, and wildfires in 1975 and 1994 destroyed much of a lush riparian gallery forest of large cottonwood trees. Many of the riparian trees and desert shrubs which appeared to have been killed by the 1994 fire are now sprouting from the roots and growing vigorously in a remarkable display of recovery. GPS receivers were used to bring control in to this site.

Rock Art

At this site, one Rock Art Form was completed. Visual analyses, photographs, written notes, and audio tape recording were used to record information. This is a highly sacred place (Stoffle et al. 1995), so the surveying and photography at the site were extensive. Fourteen rock art panels were located by the surveyors and monitored; these are located on both sides of Deer Creek Canyon. The natural impact observed is surface erosion. Human impacts include trailing on both sides of the canyon with the trail on the west being the main route into and out of the canyon. Trailing on the east side of the canyon has been caused by visitors wandering about. Other impacts include vandalism and graffiti. Pictographs on panel H have been smeared and partially rubbed off. While monitors were working at the site, a visitor was observed leaning against the panel with his hands directly on top of the pictographs. Use of the trail has caused dust to be kicked up onto the panels. Another major impact observed during the monitoring work is caused by visitor behavior: individuals go down into the canyon, using ropes and other devices to lower themselves into the creek, yelling and screaming as they go. Those actions were seen as violating the spirituality of this location.

Figure 4.6. Visitors at Deer Creek

Plants

The portions of the chasm that have the rock art panels are basically unvegetated. Isolated places in the chasm have steep, rocky talus slopes with enough soil to support some plant life, mostly across the creek from the trail. The botanist took photos of one of these places but did not visit them. Above the chasm, vegetation in Deer Creek valley is fairly complex and abundant. Cottonwood trees *(Populus fremontii)* predominate along the valley floor, along with other riparian species such as seepwillow *(Baccharis salicifolia)* and Apache plume *(Fallugia paradoxa)*. Above the floor, desert canyon vegetation is well developed. A large seep area on the north side of the creek supports luxuriant giant reed *(Phragmites australis)*. As noted above, a major wildfire in 1994 burned much of the vegetation along the valley floor from just above the chasm to the point where the stream from the spring on the north side of the valley enters the creek, a distance of about 750 m. Most of the trees, shrubs, and herbaceous perennial plant species affected by the fire were showing remarkable recovery by vigorously root sprouting when observed in July 1995. It appears that Deer Creek valley vegetation will recover naturally from the fire mainly by re-growth of the pre-existing individual plants.

One plot with selected monitoring plants was installed in the upper part of the valley about two-thirds of the distance from the upstream end of the chasm to the point where the trail crosses the creek. Focal point of the plot was a large century plant which was severely damaged by the fire but has survived. When visited during the monitoring trip it was beginning to flower. It was tentatively identified as a Palmer Agave (*Agave palmeri*) by Wendy Hodgson of the Desert Botanical Garden, who visited the site in August 1995. This is a species found in southeastern Arizona and Sonora, Mexico; it is not known to grow naturally north of the Mogollon Rim and may have been brought to Deer Creek valley through prehistoric trade.

Figure 4.7. Agave in Deer Creek valley - offsets of plant that was affected by fire in early 1994

The agave has 28 offset plants surrounding the large plant about to flower, so it will persist at the site. Three or four of the offsets went through the fire, but the others have sprouted subsequently. Seven plants were selected for mapping and monitoring, including in addition to the agave, cottonwood, coyote willow *(Salix exigua),* Goodding willow *(Salix gooddingii),* catclaw acacia *(Acacia greggii),* sacred datura *(Datura meteloides),* and locoweed *(Astragalus praelongus).* For each of these plants, height measurements were made and the number of resprouting stems was counted. All of them had their aboveground stems killed by the fire. Each plant was also located by the survey team, and all were photodocumented. A summary of information on the selected plants is found in Table 4.6.

The botanist took photographs of vegetation on a rubble slope in the chasm below pictograph panel G. This is on the opposite side of the chasm from the trail, so it is rarely if ever visited. In the long term, watching this slope for human impacts would be a measure of an increasing and expanding area of visitor usage.

Table 4.6. Vegetation Monitoring of Selected Plants at Deer Creek

Plant Number	Plant Name	Height at Tallest Point	Number of New Shoots
DC1	*Agave palmeri* (Palmer agave)	-	28 offsets
DC2	*Salix exigua* (Coyote willow)	1.7 m	12 stems
DC3	*Salix gooddingii* (Goodding willow)	0.9 m	4 stems
DC4	*Acacia greggii* (Catclaw acacia)	1.4 m	14 stems
DC5	*Populus fremontii* (Cottonwood)	1.7 m	3 stems
DC6	*Datura meteloides* (Sacred datura)	0.5 m	4 stems
DC7	*Astragalus praelongus* (Locoweed)	0.5 m	3 stems

Future Monitoring Considerations

Photographs taken at this site provide a good basis for the Southern Paiute monitoring program. The site was visited late one afternoon and again the next morning. Locating the pictographs and getting the panels surveyed was very difficult and required considerable effort. Some pictographs only become visible under certain lighting conditions, so the site requires a full day visit for thorough monitoring. Written notes are incomplete and require more careful documentation in the future.

The tentative identification of the century plant as a southern Arizona and northern Mexico species may be evidence of prehistoric trade involving plants. The monitoring plot established with the agave as a focal point can be used to document recovery following the fire of 1994.

Recommendations

This is an extremely sacred place and must be monitored annually. The SPC has determined that visitor behavior must be monitored over several days to better understand the human impacts to the site. Inappropriate visitor behavior and degradation of the pictographs were observed directly in the less than 24 hours the monitors were present at the site. The SPC would like to meet with river boatmen, park service officials, and others with responsibilities for Deer Creek visitors to develop a plan by which this place can be protected and further desecration of the canyon can be prevented. A Southern Paiute spiritual leader must visit the site to restore the spiritual feeling of the place.

Survey Stop #8 - Kanab Creek (Mile 143)

Kanab Creek originates in south central Utah and drains south through traditional Paiute lands for many miles until it enters the Grand Canyon, finally ending at the Colorado River. It has served as an access corridor to the river for many centuries. The monitoring site is located on a sandy bench on the left (east) side of Kanab Creek upstream from the Colorado River at the first major bend in the creek. The bench slopes downward from the base of the canyon wall to an abrupt, 25-foot unstable sand slope above the floor of Kanab Creek. The bench has fairly stable sandy soils and a few large boulders embedded in the sand. It is above normal old high water flows in the Colorado River and has probably not been disturbed by flooding in Kanab Creek for many decades. The sand at the site is probably of wind-blown origin, blowing up Kanab Creek from large sand dunes along the Colorado River. Several dispersed cultural elements are present, and it is likely that more are buried in the sand. The bench is bisected by a drainage which has cut sharply through the sand; the monitoring site was established on the upstream part of the bench, above the cut. Survey control was established at this site prior to this trip, but no surveying was done during the trip.

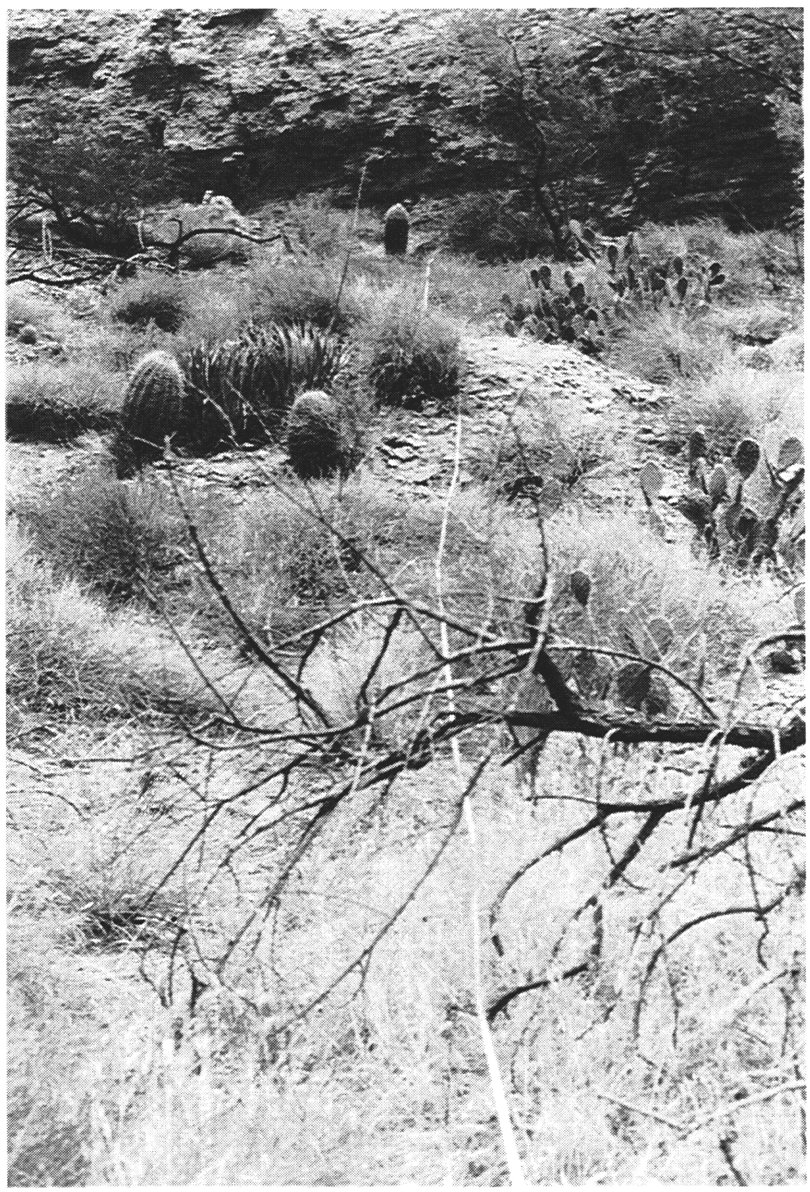


Figure 4.8. Belt transect installed in Kanab Canyon

Plants

Typical Mohave Desert vegetation is present at the site. Engelmann prickly-pear *(Opuntia phaeacantha)* is especially abundant on the lower, flatter part, while catclaw acacia *(Acacia greggii)* and Nevada Indian tea *(Ephedra nevadensis)* are dense on the upper slopes. The site receives shade from the high canyon walls during much of the day, especially in winter.

One segmented belt transect was established at the site. The transect origin is at the upper edge of a large limestone boulder about half way up the slope and goes to the base of the canyon wall, a distance of 25.3 m. A 1-m wide belt was read on the left-hand side of the tape, with segments 2 m long. In addition, a number of culturally significant plants outside the belt were measured, and their positions were recorded. The results are summarized in Table 4.7. The relative abundance of each species is calculated by dividing the number of plants of that species by the total number of all plants. The relative frequency of each species is calculated by dividing the number of cells containing the species by twelve, the total number of cells. The importance value is calculated by adding the relative abundance and relative frequency and dividing by two.

Table 4.7. Vegetation Monitoring in Segmented Belt Monitoring at Kanab Creek

Plant Name	Total	Relative Abundance	# Cells	Relative Frequency	Imp. Value
Agave utahensis (Utah agave)	1	2.4%	1	8.3%	5.4%
Ephedra nevadensis (Nevada Indian tea)	14	34.1%	7	58.3%	46.2%
Eriogenum inflatum (Desert trumpet)	1	2.4%	1	8.3%	5.4%
Gallardia pinnatifida (Blanket flower)	1	2.4%	1	8.3%	5.4%
Opuntia phaecantha (Engelmann prickly pear)	1	2.4%	1	8.3%	5.4%
Sphaeralcea grossulariaefolia (Globemallow)	9	22.0%	6	50.0%	36.0%
Sporobolus cryptandrus (Sand dropseed)	7	17.1%	6	50.0%	33.5%
Tiquilia latiro (Hispid coldenia)	1	2.4%	1	8.3%	5.4%
Xylorhiza tortifolia (Mohave aster)	6	14.6%	4	33.3%	24.0%
Total	41	100.0%	12		

Note: *Acacia greggii* (Catclaw acacia) were found 1.25 m and 1.7 m to the right of the line at 3.0 m.
Echinocereus triglochidiatus (Claretcup cactus) was found 0.2 m to the right of the line at 10 m.
Ferocctus acanthodes (California barrel cactus) were found 2.3 m to the left of the line at 8.0 m, 1.9 m to the left of the line between 10 m and 12 m, and 1.15 m to the left of the line at 13.5 m.
Stephanomeria exigua (Wire lettuce) was found 0.4 m to the right of the line at 17.75 m.

Archaeology

At this site, one Archaeology Form was completed. Visual analyses, photographs, and written notes were used to record information. The site includes four grinding stones and a hearth. No surveying was done at this site. Natural impacts observed include gullying, surface erosion across a hearth that is eroding out of a wash, bank slumpage near the grinding stones, side canyon erosion, and spalling near the artifacts. The human impact observed at the site is trailing; one trail passes alongside the site but none pass through it.

Future Monitoring Considerations

Photographs taken at this site provide a good basis for the Southern Paiute monitoring program. The plant transect was not located by the surveyors, but it should be possible to relocate it from written notes and photodocumentation. Written notes on archaeological features are incomplete, and these require more careful documentation in the future.

Recommendations

The grinding stones and the hearth at the bottom of the downstream wash require monitoring. At this point the cacti appear to be protecting the site, but trailing and other impacts should be monitored. In particular, erosion caused by the trailing needs to be carefully watched. The site should be surveyed in the future.

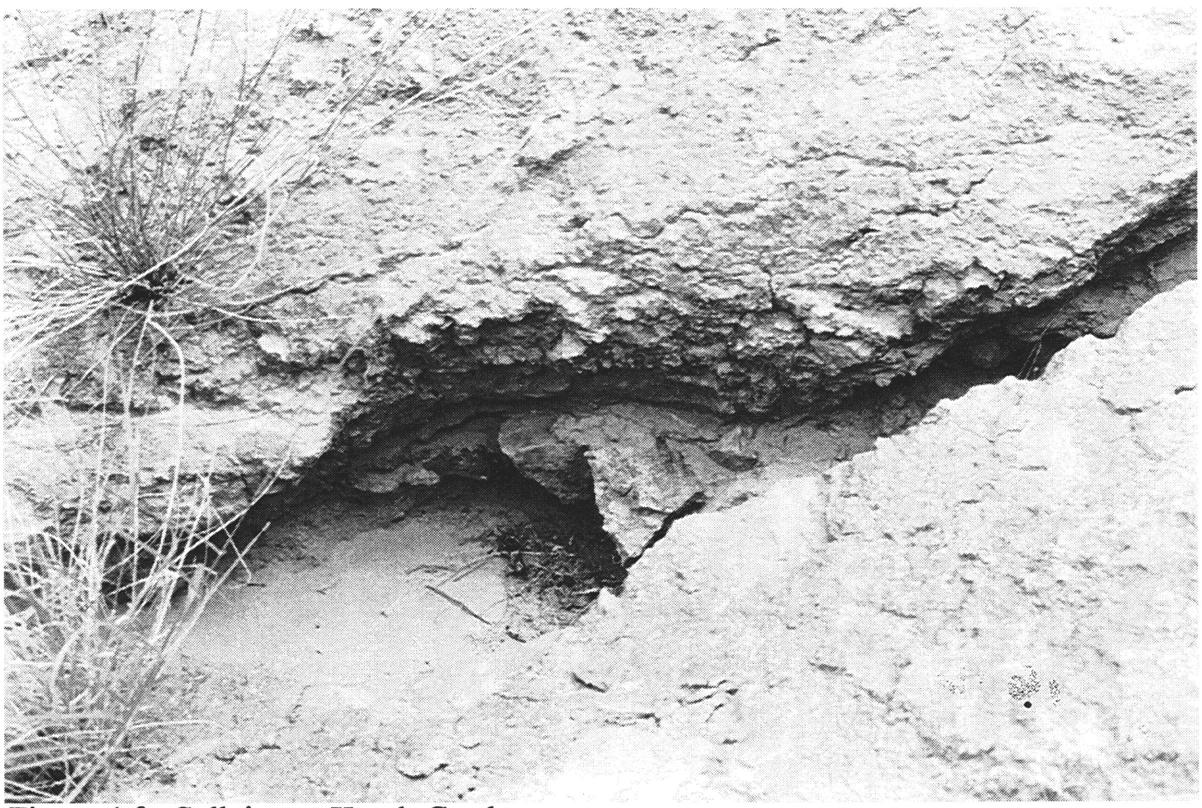


Figure 4.9. Gullying at Kanab Creek

Survey Stop #9 - Vulcan's Anvil Complex (Mile 178-180 R & L)

This is a very complex site, with five loci between Vulcan's Anvil at Mile 178 and lower Lava Falls Rapid at Mile 180 identified and surveyed. Locus #1 is Vulcan's Anvil, and information was recorded in the monitor's field notes and on a Plant Form. Locus #2 includes a rockshelter and pictograph panels, and information was recorded on both Archaeology and

Rock Art forms. Locus #3 includes a fire pit, grinding slabs and pictograph panels, and information was recorded on one Archaeology Form. Locus #4 includes a petroglyph panel that was surveyed but not monitored due to lack of time; therefore, no forms were completed at that locus. Locus #5 is a medicine spring, and information was recorded on a Plant Form. Survey control was occupied at this site.

Plants

Plant monitoring studies were carried out at two loci in the Vulcan's Anvil complex: Locus 1, on the beach opposite the Anvil at Mile 178 R; and Locus 5, the Medicine Spring in Lava Falls Marsh, Mile 179.5 L.

Figure 4.10. Establishing survey points along line intercept transect through pond at Medicine Spring, Lava Falls Marsh

The transect at Vulcan's Anvil starts atop a large conglomerate boulder located at the Colorado River shoreline directly opposite the Anvil. The transect is 35 m in length, runs across the beach, and ends in a large creosote bush in the lower portion of the talus. The line intercept method was used, recording the interval of intercept for all perennial plants along the line. Photos were taken of the end points and key places along the line, and the surveyors located these points. A complete site plant species list and botanical description were also prepared for the overall data base for the marsh and for Locus 3, as these sites were not visited during the ethnobotanical river trip in 1993 (see Appendix G). A summary of information from the transect is presented in Table 4.8. The percent cover of each plant species is calculated by dividing total length of the transect covered by that species by the total length of the transect.

Table 4.8. Plants in Line Intercept Transects at Beach Near Vulcan's Anvil

Plant Name	Location Along 35.0 m Line	Total Length (35.0 m)	Percent Cover
Acacia greggii (Catclaw acacia)	20.1-21.5, 22.0-22.2, 29.8, 30.1-30.9	2.5 m	7.1%
Dead *Acacia greggii* (Catclaw acacia)	25.6-27.9	2.3 m	6.6%
Aristida purpurea (Purple three-awn)	22.7-23.1	0.4 m	1.1%
Baccharis sarothroides (Desert broom)	2.05-2.25	0.2 m	0.6%
Bebbia juncea (Chuckwalla's delight)	0.8-0.95	0.15 m	0.4%
Cynodon dactylon (Bermuda grass)	6.5-7.6	1.1 m	3.1%
Haplopappus acradenius (Shrubby goldenweed)	13.7-16.35, 19.3-19.6, 23.1-23.3, 28.8-29.3	3.65 m	10.4%
Larrea tridentata (Creosote bush)	33.2-35.0	1.8 m	5.1%
Sporobolus cryptandrus (Sand dropseed)	16.4-16.7, 17.25-18.1	1.15 m	3.3%
Stephanomeria exigua (Wire lettuce)	18.3-18.8	0.5 m	1.4%
Tamarix chinensis (Tamarisk)	1.3-2.5, 2.5-2.75, 2.9-3.2, 3.5-5.1, 5.5-6.8	4.65 m	13.3%

At Lava Falls Marsh, a line intercept transect was installed from a point on the canyon wall 3 m downstream from the spring outlet, across the open water of the pond to the giant reed *(Phragmites australis)* band beyond the pond. The pond is about 9 m across, and in places the solid floor is as much as 1.5 m deep. Survey points located at the edges of the pond and at the margins of vegetation bands will serve to document changes in the pond and its associated vegetation in the future. Precise relocation of the transect will require surveyors relocating the survey points. Results of the Medicine Spring transect are presented in Table 4.9. The percent cover of each plant species is calculated by dividing total length of the transect covered by that species by the total length of the transect.

Table 4.9. Plants in Line Intercept Transects at Medicine Spring

Plant Name	Location Along 13.6 m Line	Total Length (13.6 m)	Percent Cover
Cladium californicum (Sawgrass)	1.6-3.5, 13.6	2.0 m	14.7%
Phragmites australis (Giant reed)	*	*	0.0%
Scirpus sp. (Bullrush)	1.6-2.7	1.1 m	8.1%
Tamarix chinensis (Tamarisk)	1.2-2.3, 3.4-4.5	2.2 m	16.2%

* Distance will be obtained from surveyor's map when available.

Archaeology

Visual analyses, photographs, and written notes were used to record information. Locus #2 includes a rockshelter and scattered artifacts. The observed natural impacts to the site include surface erosion affecting the structure and scattered artifacts at the site, spalling on the cliff wall, a rockfall in the middle of the site, and backwall slumpage. Human impacts include trailing up the steep wash to the site.

Locus #3 includes a fire pit, two grinding slicks, and three pictograph panels containing red paint. Natural impacts observed include surface erosion, conglomerate rocks eroding off the cliff, side canyon erosion, and bank slumpage. No human impacts were observed at this site.

Rock Art

Visual analyses, photographs, and written notes were used to record information. Locus #2 includes two pictograph panels. The observed natural impacts to the site include surface erosion caused by water flowing over the panels and a little soil and mud on the pictographs. Other than the trail up the wash described above, there are no human impacts to the pictographs.

Traditional Cultural Property

Vulcan's Anvil is a volcanic rock located in the middle of the Colorado River that is a traditional cultural property (TCP). Extensive photography and field notes were used to record information at Locus #1. No natural impacts were observed at the Anvil. Human impacts include shoelaces found on the upstream southside face of the Anvil and several holes that have been drilled into the upstream side of the Anvil.

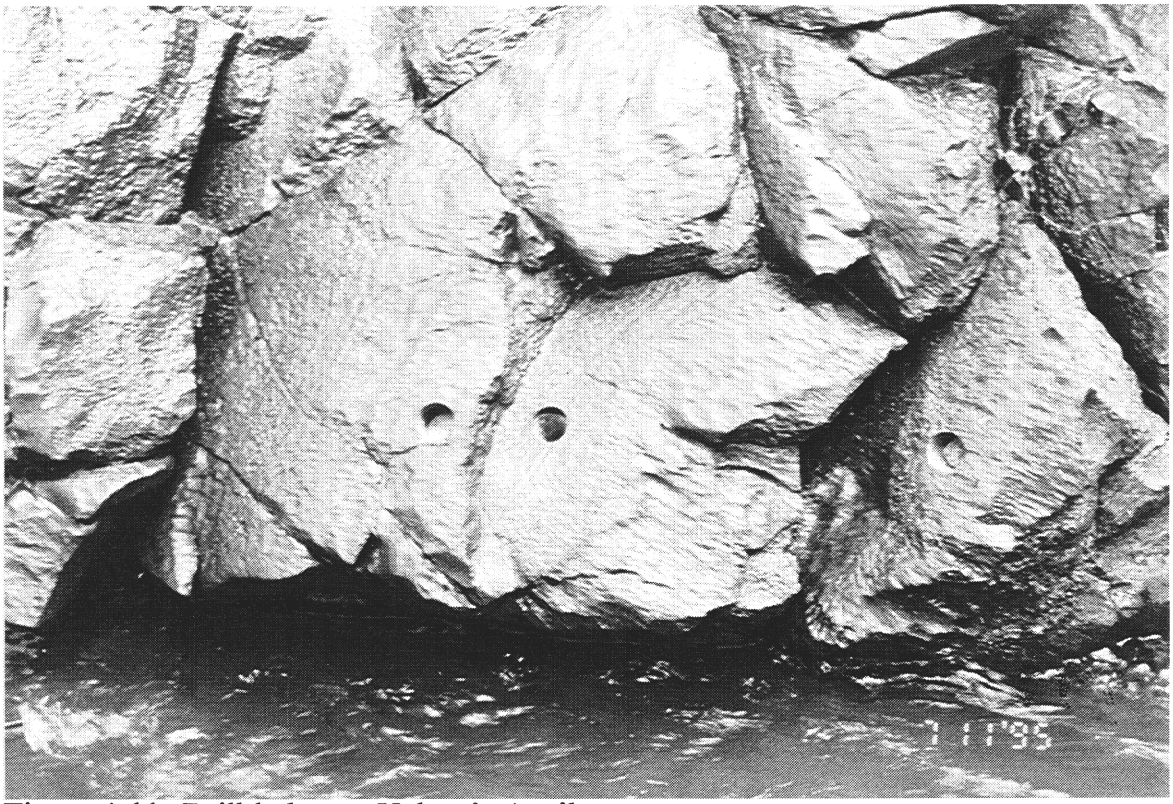


Figure 4.11. Drill holes on Vulcan's Anvil

Future Monitoring Considerations

Photographs taken at all loci provide a good basis for the Southern Paiute monitoring program. Written notes about Vulcan's Anvil are incomplete and require more careful documentation in the future. The monitor's field notes should be consulted for information. At Locus #2, special attention should be paid to the cracks in the cliff wall. The monitor was not able to visit Loci #4 and #5, so additional time should be allocated to complete the written documentation of those two places.

Future reading of the Vulcan's Anvil plant transect will provide documentation of any changes in use level on the beach opposite the Anvil. This area is now lightly used and has served as a natural setting from which ceremonial activities have been carried out by Southern Paiute and Hualapai people.

The Medicine Spring is a sacred site to both Southern Paiute and Hualapai people. It is presently lightly impacted by visitors, and, except for an obscure trail from the marsh outlet at the Colorado River, it remains largely pristine. The transect will help to document any changes in use levels, as well as natural changes in the size of the open water and vegetation belts surrounding the pond.

Recommendations

Impacts to Vulcan's Anvil appear to be less than those observed in 1992 and 1993. Tribal representatives of the SPC and the Hualapai Tribe have explained the significance of the Anvil to river boatmen, and it appears to have helped reduce impacts to the Anvil. Efforts to educate river visitors about the Anvil, such as the article in the *boatmen's quarterly review*, the newsletter of the Grand Canyon River Guides (Wegner 1993), should continue.

Survey Stop #10 - Whitmore Wash (Mile 188 R)

The focal point of the cultural resources at Whitmore Wash is a large pictograph panel upstream from Whitmore Creek. This panel is frequently visited by rafting parties, and well developed trails lead from the Colorado River shoreline to the panels and connect the site with several large overnight camps immediately downstream. In addition, a well-developed trail leads from the rim to this site. Archaeological sites are also found along Whitmore Wash, but these are not included in the monitoring program. Surveyors established control at this site.

Plants

Vegetation is not an important concern in the immediate vicinity of the pictograph panels. The trail area at the base of the cliff is mostly devoid of plants, and the Mohave Desert species present on the talus slopes below are generally sparse and typical of open, dry sites. The trail leading from the beach to the rock art site passes through dense mesquite *(Prosopis glandulosa* var. *torreyana),* and ongoing impacts to these trees are apparent in broken branches and erosion along the trail. The mesquite thicket is so dense that it is affected only along the trail, and people do not try to penetrate it elsewhere.

One line intercept transect was installed in riparian and beach vegetation about 100 m upstream from the main boat docking site for raft parties who visit the panels. The transect is 25 m long and passes through rather dense vegetation from the shore to the upper beach at the high water line from the 1983 flood. It includes a dense patch of scouring rush *(Equisetum laevigatum)* at the shoreline, a large area of well-developed arrowweed *(Tessaria sericea)* on dry dunes, and a line of young mesquite that probably germinated during the 1983 high water episode. The transect crosses two trails which were noted along with plant intercepts. This transect is in a portion of the beach which is currently lightly used, and it will record expansion in the use area by river trips and major changes in beach morphology and vegetation that could result from spike or sustained high water releases from Glen Canyon Dam. Data collected on the transect is summarized in Table 4.10. Survyeors located the transect line endpoints and several other points along the line. The percent cover of each plant species is calculated by dividing total length of the transect covered by that species by the total length of the transect.

Table 4.10. Plants in Line Intercept Transects at Beach Below Whitmore Wash

Plant Name	Location Along 25.0 m Line	Total Length (25.0 m)	Percent Cover
Cynodon dactylon (Bermuda grass)	4.0-4.3, 4.6-5.0, 5.4-8.8, 10.8-20.9	14.2 m	56.8%
Equisetum laevigatum (Scouring rush)	0.1-1.6, 2.4-8.3, 9.4-10.3, 10.6-16.1, 16.5-16.8, 17.3-17.4, 17.8-19.4, 23.0-23.5	16.3 m	65.2%
Juncus torreyi (Torrey rush)	0.0-0.6	0.6 m	2.4%
Prosopis glandulosa var. *torreyana* (Torrey mesquite)	10.7-13.2	2.5 m	10.0%
Tessaria sericea (Arrowweed)	2.9-3.3, 3.6-3.8, 4.5-4.7, 5.0-6.6, 9.2-9.5, 14.7-14.8, 15.3-15.5, 20.5-20.9, 22.8-23.1	3.7 m	14.8%
Dead *Tessaria sericea* (Arrowweed)	15.3-20.1, 21.8-22.7, 23.5-24.2	6.4 m	25.6%
Typha latifolia (Cattail)	0.0-0.7	0.7 m	2.8%

Rock Art

One Rock Art Form was completed at this site. Visual analyses, photographs, and written notes were used to record information. This site contains a large, complex rock art panel. The observed natural impacts at this site include surface erosion from water running over the panel, and soil and mud impacting the panel. Human impacts include a well-used trail, dust cover on the panel caused by foot traffic near the panel, gullying due to water running down the trail to the side wash on the upstream side of the site, and extensive graffiti all along the panel.

Future Monitoring Considerations

Photographs taken at this site provide a good basis for the Southern Paiute monitoring program. Despite many previous visits to photograph the rock art panels, figures and graffiti that had never been recorded were observed during an early evening monitoring session. Photos were taken of all visible rock art. Written notes are incomplete and require more careful documentation in the future.

The plant transect was photodocumented by the botanist. There are no marked or relocatable landmarks along the transect; the endpoints and points at each 5 m along the transect were located by the surveyors, so surveyors must relocate the transect for re-reading. The 0 point of the transect was at the edge of the low bank at the water's edge at a flow of about 20,000 cfs. Bank erosion and different flow levels will affect the relative position of this point for future relocation.

Recommendations

This site should be monitored every year with special attention paid to human impacts. Monitoring should be done in the evening to ensure that all the figures can be seen and information about them recorded. This site receives heavy visitation and has been affected by more graffiti than any other site visited during the 1995 monitoring trip. Visitors should be carefully watched while at this site. Some of the graffiti is located on the upper pictograph panels suggesting unsupervised visitors from the downstream overnight camps or the rim.

Survey Stop #11 - Above Parashant (Mile 197 R)

This is a rather unique site with rock art panels found at the base of a basalt flow cliff. *Ompi* has formed at a contact point with the lava. The site is in an area where the Colorado River and Inner Gorge were accessed from the rim through Parashant Canyon. The basalt ledge is a remnant of one of the many lava flows that entered the canyon from the rim about 20 miles upstream, causing numerous episodes where the canyon was dammed, followed by gradual erosion of the lava by the river as it returned to its base level. Remnants of these flows are often seen as low lava cliffs above the present shoreline. Surveyors established control at this site.

Plants

This site is on a narrow beach that is rather heavily vegetated. Along the shoreline scouring rush (*Equisetum laevigatum*) and Bermuda grass *(Cynodon dactylon)* protect the sand bank from erosion, and large tamarisk *(Tamarix chinensis)* and desert broom *(Baccharis sarothroides)* grow in a riparian strip. Above the shoreline, arrowweed (*Tessaria sericea*) is dense, and in the OHWZ at the base of the cliffs large mesquites (*Prosopsis glandulosa* var. *torreyana*) and acacias (*Acacia greggi*) form an impenetrable thicket. The distance from shoreline to cliff base is about 60 m.

One line intercept transect was placed from the shoreline to the lower edge of the mesquite-acacia zone. The 0 point was on the low, steep bank at the water's edge at a flow of 20,000 cfs. The transect passes through the marshy riparian zone, through arrowweed in the center, and to the lower part of the acacias, ending on a large basalt rock at 35 m. The rock art site is about 20-25 m beyond the endpoint. Two trails cross the line; one is along the shoreline, and the other is the main access trail to the pictographs. These were both noted on the Plant Form. Surveyors located the endpoints and points at 5 m intervals along the transect. Data from the transect are presented in Table 4.11. The percent cover of each plant species is calculated

Table 4.11. Plants in Line Intercept Transects Above Parashant Wash

Plant Name	Location Along 35 m Line	Total Length (35 m)	Percent Cover
Acacia greggii (Catclaw acacia)	16.6-17.2, 17.9-18.1, 18.5-18.8, 19.8-20.3, 21.6-21.9, 24.8-25.5, 33.6-35.0	4.0 m	11.4%
Aristida purpurea (Purple three-awn)	8.1-8.2, 9.5-10.5, 10.9-11.7, 14.9-15.2, 16.3-16.8, 20.6-20.9	3.0 m	8.6%
Aster spinosus (Spiny aster)	3.1-3.7, 5.4-5.5	0.7 m	2.0%
Baccharis sarothroides (Desert broom)	6.1-9.7	3.6 m	10.3%
Clematis lingusticifolia (Western virgin's bower)	0.9-2.9	2.0 m	5.7%
Cynodon dactylon (Bermuda grass)	1.4-6.3	4.9 m	14.0%
Equisetum laevigatum (Scouring rush)	0.6-3.8, 5.3-5.5	3.4 m	9.7%
Erigeron lobatus (Lobeleaf fleabane)	7.7-7.8	0.1 m	0.3%
Gutierrezia microcephala (Snakeweed)	9.2-9.5, 12.2-12.5, 19.8-20.1	0.9 m	2.6%
Mammillaria microcarpa (Pincushion cactus)	34.6-34.7	0.1 m	0.3%
Opuntia basilaris (Beavertail cactus)	26.3-27.0	0.7 m	2.0%
Phoradendron californicum (Desert Mistletoe)	34.8-35.0	0.2 m	0.6%
Prosopsis glandulosa var. *torreyana* (Torrey mesquite)	21.5-23.7, 21.9-24.3, 24.3-25.7, 26.0-29.4, 32.1-33.8	11.1 m	31.7%
Sporobolus cryptandrus (Sand dropseed)	7.2-7.6	0.4 m	1.1%
Stanleya pinnata (Prince's plume)	33.8-33.9	0.1 m	0.3%
Stephanomeria exigua (Wire lettuce)	14.6-15.5, 16.3-16.6, 17.5-17.8, 18.0-18.2	1.7 m	4.9%
Tamarix chinensis (Tamarisk)	0.4-0.7, 1.4-2.5, 3.5-3.9	1.8 m	5.1%

by dividing total length of the transect covered by that species by the total length of the transect. A complete site plant species list and a habitat description were also prepared for the overall database as this site was not visited during the ethnobotanical study in 1993 (see Appendix G).

Archaeology

At this site, one Archaeology Form was completed. Visual analyses, photographs, and written notes were used to record information. The site includes fire pits and a grinding stone. These were not surveyed. The primary observed natural impact to the fire pits is bank slumpage. Human impacts, principally trailing near the fire pits, have increased since this site was first studied in May 1994.

Rock Art

One Rock Art Form was also completed at this site. Visual analyses, photographs, and written notes were used to record information. The site includes a series of rock art panels at the base of a basalt cliff and a red paint source. The boundaries of the rock art panels were located by the surveyors. Natural impacts to the area near the panels include spalling on the cliff face and apparent erosion of the anthropomorph and sheep figures caused by rainfall since the 1994 visits to the site. Human impacts include trailing, trampling of the vegetation that was next to the panels during the 1994 visits, surface erosion in front of the panel caused by the trailing, and possible vandalism wherein one rock was chipped by another.

Future Monitoring Considerations

Written notes and photographs taken at this site provide a good basis for the Southern Paiute monitoring program. The plant transect was photodocumented by the botanist. Surveyors will be required to accurately relocate the transect; the rock at the upper end could be found with photos, but there are no additional landmarks along the line.

Recommendations

This site is fairly well protected by a covering of mesquite and catclaw. Nevertheless, the area in front of the panels appears to have become a picnic stop for river runners, and the vegetation has been trampled and moved back from the panels. The site should be monitored annually to determine whether human impacts are increasing and provide information for the possible development of additional recommendations for protection of the site. The plant transect will provide future information on increased trailing and vegetation disturbance below the site. The archaeological features should be surveyed in the future.

Survey Stop #12 - *Ompi* Cave (Mile 200 R)

Traditional Cultural Property

At this site, one Archaeology Form was completed. The site contains a large hematite cave, and it was not surveyed. No survey control exists at this site. The monitor did not climb the trail to the cave or enter the cave because of spiritual reasons. Visual analyses, photographs, and written notes were used to record information about the impacts to base of the cave and the beach in front of it. Natural impacts to the area in front of the cave include erosion caused by rainfall, arroyo cutting that is beginning beneath the cave and extends to the river, bank slumpage associated with the arroyo, and spalling. Human impacts include widening of the trail since the 1994 visits to the site and a hematite rock laying on the ridge across from the front of the cave that appears to have been brought there.

Future Monitoring Considerations

Written notes and photographs taken at this site provide a good basis for the Southern Paiute monitoring program. Additional notes and a visit to the interior of the cave will be required in the future.

Recommendations

This site should be closed to the public. The cave should not be entered except as part of ceremonies by people who are knowledgeable about the purpose and use of *ompi*. The SPC must educate river boatmen and NPS officials responsible for visitor behavior about the site and restrictions on its use. A plan for protection of the site, such as possible creation of educational materials or signs, should be discussed. Existing trails and past impacts should be monitored. Complete monitoring of the site requires that it be visited by both male and female monitors.

Figure 4.12. Erosion at Ompi Cave

Survey Stop #13 - Spring Canyon (Mile 204 R)

The floor of Spring Canyon was scoured by flash floods occurring in February 1993 and March 1995. In both events, the stream bed was widened and most vegetation was removed. Only a few small islands of vegetation remain, and a few buried logs are beginning to sprout to form new riparian trees. Both events affected mostly the gravel bed along the lower portion of the creek within and below the OHWZ; upstream, where the floor and banks are more stable, there was less effect.

Surveyors established control at this site. A series of ten transects was placed wall-to-wall, bank-to-bank across Spring Canyon from upstream of the outcrop to the Colorado River. All were located by the surveyors. Five were set up in order to monitor recovery of the riparian plant community in lower Spring Canyon. These transects provide a means of monitoring the effects of side canyon flooding on vegetation and the size and condition of the stream channel.

Plants

Five transects crossing Spring Canyon were established as line intercept transects for plant monitoring. These showed dense vegetation at the 0 points (downstream, with respect to the Colorado River) and end points, where dense vegetation remains on the banks. The main part of each transect, where it crosses the scoured floor of Spring Canyon, is devoid of vegetation except for a few remnant islands that survived the floods. Little evidence of re-vegetation and recovery from the 1995 flood was noted at the time of the monitoring trip some four months later. Data from the five plant transects are shown in Table 4.12. The percent cover of each plant species is shown in the table and was calculated by dividing total length of the transect covered by that species by the total length of the transect.

A selected plant monitoring plot was established at the rock art panel, between the base of the rock outcrop and the steep bank of Spring Canyon. Fifteen plants of eight species were selected, including five individuals of wild tobacco *(Nicotiana trigonophylla)*. The plant locations were mapped by the survey crew, and their height and width were recorded. Photos of each plant were taken. Particulars on plants in the plot are presented in Table 4.13.

Archaeology

At this site, one Archaeology Form was completed. Visual analyses, photographs, and written notes were used to record information. The site contains a rockshelter with a hearth, two grinding stones, a grinding slab, and Indian tobacco inside. The rockshelter was located by the surveyors. Natural impacts to the site include surface erosion inside the rockshelter and side canyon erosion in the wash below the rockshelter due to the major flash floods that have occurred in Spring Canyon in recent years. Human impacts include erosion and bank slumpage caused by a trail climbing a steep bank to the rockshelter, trampling of vegetation, and removal of artifacts from the rockshelter. The grinding stones were present in 1994, had disappeared in April 1995, and had reappeared in new locations in July 1995. The movement of artifacts suggest they had been hidden and returned by a frequent visitor to the site.

Table 4.12. Plants in Line Intercept Transects at Spring Canyon

Plant Name	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5		Total Site	
	Total Length (9.8 m)	Percent Cover	Total Length (8.8 m)	Percent Cover	Total Length (27.7 m)	Percent Cover	Total Length (29.3 m)	Percent Cover	Total Length (14.3 m)	Percent Cover	Total Length (89.9 m)	Percent Cover
Acacia greggii (Catclaw acacia)					1.5 m	5.4%					1.5 m	1.7%
Baccharis salicifolia (Seepwillow)	1.0 m	10.2%					3.3 m	11.3%	0.9 m	6.3%	5.2 m	5.8%
Baccharis sarothroides (Desert broom)	1.5 m	15.3%	1.0 m	11.4%							2.5 m	2.8%
Brickellia longifolia (Brickellbush)			0.5 m	5.7%	2.7 m	9.7%					3.2 m	3.6%
Cynodon dactylon (Bermuda grass)									1.7 m	11.9%	1.7 m	1.9%
Datura meteloides (Jimsonweed)							1.1 m	3.8%	0.5 m	3.5%	1.6 m	1.8%
Phragmites australis (Giant reed)									2.1 m	14.7%	2.1 m	2.3%
Prosopis glandulosa var. *torreyana* (Torrey mesquite)					3.5 m	12.6%			1.8 m	12.6%	5.3 m	5.9%
Salix exigua (Coyote willow)									1.3 m	9.1%	1.3 m	1.4%
Stanleya pinnata (Prince's plume)			0.7 m	8.0%							0.7 m	0.8%
Tamarix chinensis (Tamarisk)	1.5 m	15.3%			1.7 m	6.1%	2.9 m	9.9%	5.2 m	36.4%	11.3	12.6%
Tessaria sericea (Arrowweed)					1.1 m	4.0%	1.3 m	4.4%			2.4 m	2.7%

Note: Eleven transects were placed at this site; only five were used to monitor plants. Transect 11 is in the Colorado River (at ca 14,000 cfs) across the mouth of Spring Canyon. It was not read on the July 1995 trip.
Transect 4 has remnant vegetated islands, at 15-16 m and 19-22 m.

Table 4.13. Plants in Selected Monitoring Plot at Spring Canyon

Plant Number	Plant Name	Height at Tallest Point	Width at Widest Point
1	*Nicotiana trigonophylla* (Wild tobacco)	60 cm	30 cm
2	*Nicotiana trigonophylla* (Wild tobacco)	15 cm	3 cm
3	*Nicotiana trigonophylla* (Wild tobacco)	60 cm	40 cm
4	*Acacia greggii* (Catclaw acacia)	1.25 m	1.17 m
5	*Nicotiana trigonophylla* (Wild tobacco)	53 cm	25 cm
6	*Ziziphus obtusifolia* (Gray thorn)	3 m	1.75 m
7	*Baccharis sarothroides* (Desert broom)	3 cm	5 cm
8	*Sphaeralcea grossulariaefolia* (Globemallow)	0.92 m	1.10 m
9	*Lycium fremontii* (Wolfberry)	0.83 m	1.25 m
10	*Nicotiana trigonophylla* (Wild tobacco)	30 cm	20 cm
11	*Nicotiana trigonophylla* (Wild tobacco)	55 cm	32 cm
12	*Acacia greggii* (Catclaw acacia)	2.2 m	1.1 m
13	*Encelia farinosa* (Brittlebush)	92 cm	42 cm
14	*Larrea tridentata* (Creosote bush)	1.23 m	2.3 m
15	*Sphaeralcea grossulariaefolia* (Globemallow)	1.05 m	0.75 m

Rock Art

One Rock Art Form was completed at this site. Visual analyses, photographs, and written notes were used to record information. The site contains one panel of red pictographs and three Indian tobacco plants. The panel was located by the surveyors. Natural impacts include surface erosion and vegetation that was growing up in front of the panel. That vegetation has been trampled down and is not presently impacting the panel. Human impacts include trailing, bank slumpage in the wash at the trail, trampling of vegetation, and graffiti dating from 1923.

Animals

A dead Grand Canyon rattlesnake was found about 20 yards up the wash from the rockshelter. Rocks had been placed on top of the snake, and its death may have been caused by humans. Two pink rattlesnakes had been observed at this location during previous Paiute study trips. This is apparent evidence of direct visitor impact to snakes at sites that are culturally significant to the Paiutes. Photographs were taken of the snake and written notes are included in the general discussion of the site on the first page of the Archaeology Form.

Future Monitoring Considerations

Written notes and photographs taken at the rockshelter provide a good basis for the Southern Paiute monitoring program. The photographs of the rock art panels are poor. These photos were taken in the morning under direct sunlight.

Photodocumentation and a plot map drawn by the botanist will assist in relocation of the individual monitoring plants. The plants were mapped by the surveyors, and exact relocation is possible if a survey crew is available. Relocation of the cross-canyon transects will depend upon surveyors; the 11 transects were not established with relocatable endpoints.

Recommendations

Due to the problems with the lighting on the rock art panel, this site should be visited in late afternoon and new photographs taken of the panel. The rockshelter should be monitored every year with particular attention to the bank erosion and removal of artifacts. The trailing at the rock art panels can also be monitored at the same time. The transects should be set every year to measure changes in the wash and effects of side canyon flooding on vegetation and channel width.

Survey Stop #14 - Indian Canyon (Mile 206.5 R)

This site was not visited on the July 1995 trip due to lack of time. This site should be included in the 1996 monitoring program.

Survey Stop #15 - Pumpkin Spring (Mile 212.8 L)

This site includes a travertine spring that has been identified as a potential TCP. Surveyors established control at this site.

Traditional Cultural Property

At this site, one Traditional Cultural Property Form was completed. Visual analyses, photographs, and written notes were used to record information. The site includes Pumpkin Spring, and the entire circumference of the spring was located by the surveyors. The overall condition of the spring is good. An observed natural impact to the spring is the gullying occurring immediately above the spring. The spring is draining directly into the river from its downstream edge. Human impacts include on-site camping, trailing to the spring, and black marks on the outside of the spring from boats bumping into the travertine. The mud that was covering the walls surrounding the spring during April 1995 that had apparently been thrown there by visitors was not seen on the July 1995 trip.

Future Monitoring Considerations

Written notes and photographs taken at the rockshelter provide a good basis for the Southern Paiute monitoring program. Additional photographs, particularly from the boat looking at the travertine shell, are needed.

Recommendations

Pumpkin Spring should continue to be monitored. Annual monitoring should occur for at least a few years to establish a more complete understanding of both natural and human impacts to the spring.

SUMMARY AND CONCLUSIONS

The SPC successfully completed the initial development and field testing of its long term monitoring program in the *Colorado River Corridor*. Native American monitoring is a complex process that requires attention to many types of cultural resources, such as rock art panels and plant commuities, and to both physical and spiritual impacts. It requires a carefully planned and implemented monitoring program and cannot be handled as casually as it was prior to 1995 when Southern Paiutes sent monitors as observers on other monitoring trips through the *Colorado River Corridor*. The Southern Paiute monitoring program includes *cultural resource sites*, and both overall site assessments and impacts to specific features such as archaeological materials or plants are monitored at each site. It is important to note that only the location and size of individual cultural resources, such as plants or rock art panels, were located by surveyors during 1995; the boundaries of entire cultural resource sites must be defined and located in the future.

Because of their importance to the cultural resource sites that had been identified in 1995, plants were monitored at several places that had not been visited during the 1993 ethnobotany study. Site descriptions for those sites are included in Appendix G. Also, several sites include plants that are known to be culturally significant to Paiutes but were not among the 68 plant species identified during the 1993 study. These plants were included in the monitoring program and serve as a reminder that new information will continue to be gathered through ethnographic research on cultural resources in the *Colorado River Corridor* and must be incorporated into the monitoring program.

In addition, a few places such as Deer Creek and Kanab Creek are essential elements of the Southern Paiute cultural landscape that includes the Colorado River but that fall outside the *Colorado River Corridor* (see Chapter One). These places must be added to the GCES-GIS. Some sites, such as *Ompi* Cave and Spring Canyon, are within the *Colorado River Corridor* but outside of the 15 Long-Term Monitoring Sites of the GCES-GIS (see Chapter Three). These sites have been located, but no additional information can be associated with them at this time. The inclusion of monitoring stops both in and out of the Long-Term Monitoring Sites provides the SPC an opportunity to evaluate the usefulness and appropriateness of participation in the GCES-GIS program.

Fourteen monitoring sites were established, and data about these sites were recorded in monitoring notebooks. The majority of sites are receiving both natural and human impacts. Natural impacts include surface and wash erosion, spalling, rockfalls, and bank slumpage. Human impacts include trailing, gullying in trails, trampling of vegetation, vandalism, and graffiti on rock art panels. Site-specific impacts, such as the removal (or hiding) of artifacts from Spring Canyon, require special attention.

The SPC monitoring team must include both tribal monitors and Southern Paiute elders. At a minimum, two SPC monitors are needed at all times during the on-site monitoring. These individuals require some specialized training (see Chapter Six), but much of what they bring to the program is their experience. Each year at least one experienced monitor must participate in on-site monitoring so the sites can be located, procedures replicated, and necessary adjustments made to the overall program. Two individuals can support one another and provide depth to the monitoring program. On each trip, an experienced monitor can help train new monitors until the SPC has a skilled team of monitors. In addition, the monitors should be accompanied by at least two tribal members knowledgeable about ceremonial practices and prayers that must be conducted prior to entering certain places. Two individuals will bring different types of knowledge to perform ceremonies and can provide advice to the monitors. They will also be able to relieve one another in case of illness or fatigue.

During the July 1995 monitoring trip, SPC monitors worked directly with GCES surveyors to locate sites. Many of these sites must be relocated by surveyors each time they are monitored. SPC monitors also

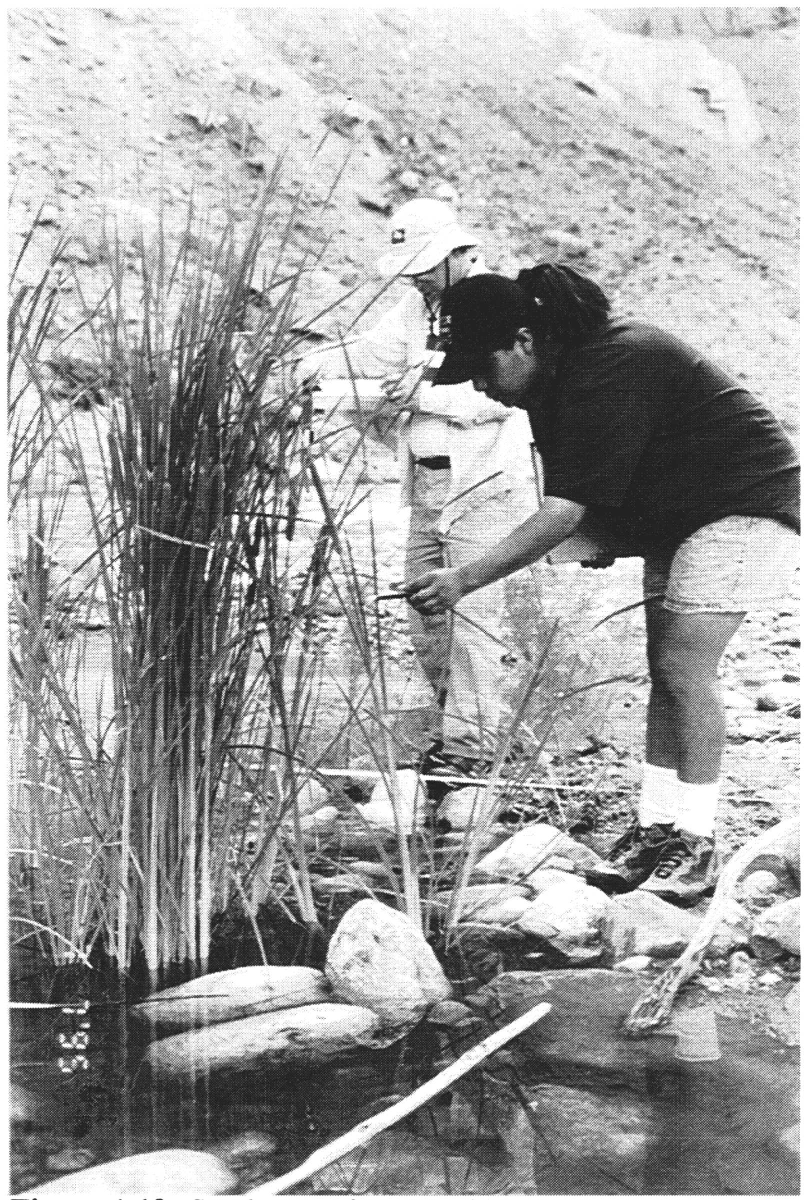


Figure 4.13. Southern Paiute Monitor gets help from project botanist identifying *Typha latifolia* (Cattail) at Whitmore Wash

worked closely with an experienced Grand Canyon botanist to develop and implement the plant monitoring activities. They will continue to require a botanist's participation during monitoring trips until they have developed sufficient botanical knowledge and skills to complete the plant monitoring without assistance. Finally, the SPC continues to receive technical assistance from ethnographers from the UofA. These ethnographers provide organizational and research expertise and facilitate the transfer of cultural knowledge into policy.

Not all SPC monitoring sites can be monitored effectively during an eleven-day river trip. During the 1995 river trip, monitoring was not begun at one site and was incomplete at several others. Also, some sites require that monitors be present at the site for several days to adequately measure the impacts to the cultural resources. Animals still present a special challenge for monitoring. No systematic monitoring of impacts to animals was attempted because the monitors had insufficient time in any one location to observe animals and their habits along the Colorado River, and it is not clear how to monitor animals whose territory extends beyond the river's edge. Visitor impacts at several sites are poorly understood. More extensive monitoring of visitor behavior at a single site, such as Deer Creek, will require the monitoring team to stay in one location for several days (see Chapter Six).

One way to lengthen stays at some monitoring sites while ensuring that all are included in the monitoring program is to design a 3-5 year monitoring cycle wherein only some of the sites are visited annually and the others are monitored less frequently. On-site monitoring can itself cause impacts to sites, and this should be considered when the frequency of monitoring visits is determined. The monitoring program also can be designed to include long stays at one or two designated sites each year. The choice of sites and purposes can change to meet the needs of the monitoring program. Other issues, such as whether SPC monitoring should occur at different times of the year to permit the study of seasonal variation in impacts, must also be considered. Consequently, significant time must be allocated in the 1996 program schedule for design of the monitoring program, development of monitoring notebooks, and training of the monitors.

CHAPTER FIVE

SOUTHERN PAIUTE CONSORTIUM *COLORADO RIVER CORRIDOR* EDUCATION PROJECT

Southern Paiute youth are the future. The Southern Paiute Consortium *Colorado River Corridor* Youth Environmental Education Program begins a process that will assure that even better informed tribe-to-agency interactions can occur between the Southern Paiutes and the Bureau of Reclamation (BOR) in the future. Therefore, the youth environmental education program has been closely tied to the work of the survey and monitoring program. Concepts that are the primary focus of the Southern Paiute youth environmental education program have been grouped into four topical areas (1) water in the Colorado River, (2) geology of the Grand Canyon, (3) biology of the Colorado River Corridor, and (4) anthropology of the Southern Paiute people.

The environmental education program was begun in March 1995. The purpose of the program is to integrate Southern Paiute resource knowledge about the Glen Canyon Environmental Studies (GCES) / Glen Canyon Dam and make that knowledge available to Southern Paiute youth to ensure that the Southern Paiute Consortium (SPC) will continue to be able to meet its responsibilities for adaptive management in the *Colorado River Corridor*. The principal goal of the program is to combine Western scientific and traditional Southern Paiute ways of knowing about the study area to help Paiute youth explore the four topics that are the focus of the program. Throughout the program fundamental tenets of these ways of knowing, such as the significance of systematic data collection to science and the importance of performing appropriate ceremonies before entering certain sacred places to Southern Paiute traditional culture, are emphasized and practiced.

Prior to the July 1995 river trip, eight Kaibab Paiute youth participated in meetings and activities held at least once a month from April to June. The Coordinator of the SPC and the University of Arizona (UofA) consultant recognized that one way to encourage consistent youth participation in the program would be to develop a program that would enable students to earn academic credit. The Coordinator and the Superintendent of the Fredonia School District established a system of accountability for student participants. The activities included in the youth environmental education program are (1) orientation and study meetings, (2) a trip to the Bureau of Reclamation/National Park Service Site Stabilization Workshop held at Marble Canyon in May, (3) a one day trip upriver from Lees Ferry to study petroglyphs and be introduced to the Glen Canyon Recreation Area archaeological monitoring program, (4) a one day trip to

House Rock Valley to visit a Southern Paiute living site in the valley, to experiment with an atlatl, and to meet with a geologist about the sink holes on the mountain, and (5) the eleven-day Colorado River trip. These activities were set up to introduce the youth to the Colorado River ecosystem, Southern Paiute aboriginal territory, and Glen Canyon Dam. The trip to House Rock Valley was cut short due to poor weather and was not rescheduled. The river trip began at Lees Ferry on July 5 and continued until take out at Diamond Creek on July 15. After the river trip, the Kaibab Paiute youth met to write summary reports and prepare a final presentation. The 1995 youth environmental education program concluded with a formal presentation to the Kaibab Paiute Tribal Council and Southern Paiute community. The superintendent of the Fredonial School District attended the presentation as well. Each Kaibab Paiute youth participant gave an oral presentation accompanied by slides and/or video taped material. Several of the high school students received academic credit for their participation in the youth environmental education program.

The core of the youth environmental education program is the eleven-day river trip. All other activities were designed to prepare youth for the trip or share trip experiences with other tribal members. Therefore, the remainder of this chapter will describe the river trip activities in greater detail.

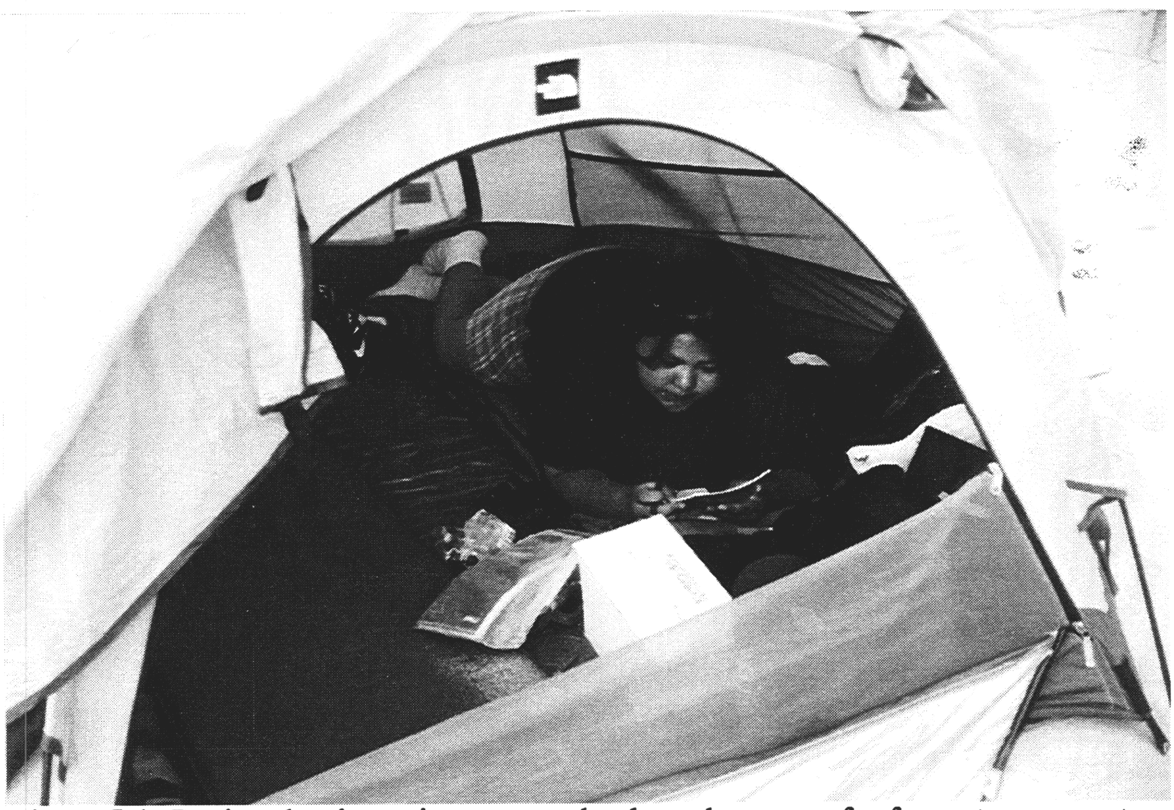


Figure 5.1. During the river trip, one youth takes advantage of a few extra moments before dinner to catch up on the day's notes

METHODOLOGY

Each of the tribal governments appointed a tribal elder and four or five youths to represent them during the July river trip (see Acknowledgements for a list of youth participants on the river trip). The youths ranged in age from 11 to 16 years. In addition, a Kaibab Paiute tribal council representative and one consultant from the UofA participated in the trip. Due to family emergencies, four youths, the Shivwits elder, and the tribal council representative left during the trip by helicopter from Phantom Ranch.

The program goal of combining Western scientific and traditional Southern Paiute ways of knowing has been addressed through a coordinated program of activities that include the following three approaches:

(1) Immerse students in the study area environment and allow them to observe, participate in, and record what they have learned as scientific data is collected by GCES researchers and as traditional ceremonies and activities are conducted by Southern Paiute elders.

(2) Identify and focus upon two topics that highlight the complementarity and differences between scientific and traditional Southern Paiute ways of knowing. These two topics are human occupation and use of the *Colorado River Corridor* and plant and animals within the *Corridor*. Information is shared through oral stories, written text, diagrams, and maps.

(3) Identify and perform activities that illustrate specific environmental concepts such as the formation of the *Colorado River Corridor*, the importance of water in the study area, and the impact of Glen Canyon Dam on the environment below the dam. These concepts have been explored through the systematic investigation of topics such as the role of volcanic and sedimentary activities and of water in the formation of the canyons, channels, and beaches. Other topics include the importance of water to the plants and animals, including humans, that live(d) in the *Corridor* and to the humans, including power producers, power users, recreationists, and agriculturalists, that use the *Corridor* or water but live elsewhere.

Environmental educational activities were developed by the UofA consultant in consultation with SPC representatives. Both site-specific and general tasks were included in the environmental education program to allow program leaders maximum flexibility so they could coordinate program activities with the survey and monitoring tasks. Daily activities were determined after a morning meeting among trip participants during which anticipated stops and time periods were set. Activities were documented in writing, through photographs, and through audio and video recording.

In addition to the group activities, each of the Kaibab Paiute youth representatives selected a specific topic to study prior to and during the river trip, and time was set aside throughout the trip for the individual youths to complete activities related to their research and to share the results of their work with the other youth participants. Two Shivwits Paiute youth representatives designed and carried out interviews with a Paiute elder who participated in the trip. These youths prepared interview questions, completed two interviews, and documented their work on audio and video tapes.

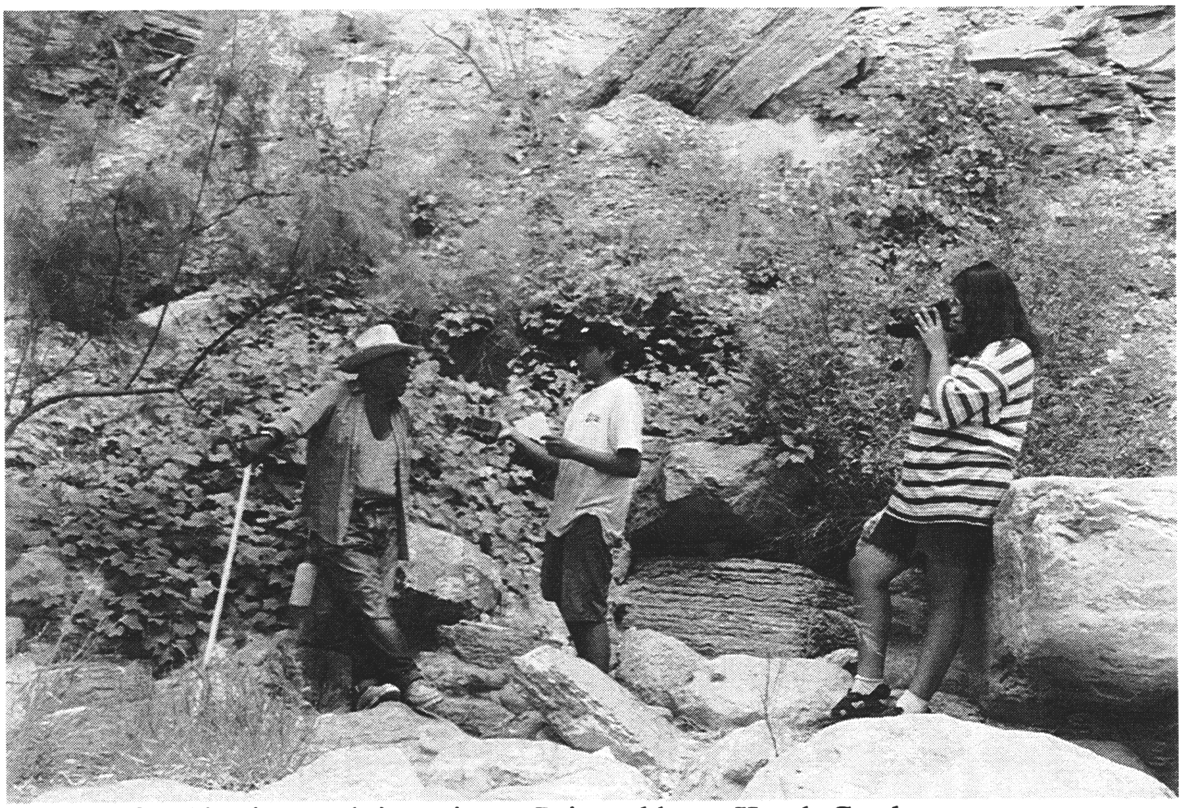


Figure 5.2. Shivwits youth interview a Paiute elder at Kanab Creek

THE ENVIRONMENTAL EDUCATION PROGRAM

Program Concepts

The following concepts have been selected within each program topic.

1. Water in the Colorado River

The primary environmental issue that frames all other investigations that are presently taking place within the *Colorado River Corridor* is the management of Glen Canyon Dam. Throughout their study, students were seeking answers to the following questions:

a. Who are the water users (human and non-human)?
b. Why do they use the water?
c. How do they use the water?
d. What factors are most important in determining whether they can or cannot use the water (i.e. temperature, amount, oxygen)?
e. How does the dam affect each of the factors identified in part d?

2. Geology of the Grand Canyon

The geology component focused on two topics: (1) the history and origin of the Grand Canyon, as told through the rocks; and (2) the geology of important minerals and features in the river corridor. Six concepts form the basis of the geology component of the program.

a. Major geologic periods observed in the rocks of the study area; Southern Paiute interpretation of the area's history
b. Types of rocks: igneous, metamorphic, and sedimentary
c. Relationship between rock type and erosion (differential erosion); especially the effects on channel width and debris flows
d. Formation of rapids, riffles, eddies and sand bars
e. Relationship between particle size and sediment transport
f. Origins of salt, hematite, and Vulcan's Anvil - both in geologic and traditional Paiute teachings
g. Impact of the dam on deposition, erosion, and sediment transport

3. Biology of the Colorado River Corridor

The focus of the biology component was plants, plant communities, and ecological relationships within the river corridor. The students were led to compare Southern Paiute knowledge about plants and their relationships to what is around them to the western scientific understanding of these relationships. Six components form the basis of the biology component of the program.

a. Basic requirement of living things: water, sun, nutrients
b. Ecosystems within the *Colorado River Corridor*; defining and identifying ecosystems and comparison of ecosystem concept with traditional Paiute views of interrelatedness of all things
c. Relationships between organisms and their habitats
d. Effect of changing environmental conditions on ecosystems
e. Identification and observation of specific plant and animal relationships within the *Colorado River Corridor*
f. Impact of the dam on species composition in and along the river

4. Anthropology of Southern Paiute People

The anthropology component focused on archaeology and rock art sites in the river corridor. Five concepts form the basis of the anthropology component of the program:

a. Stories of human life within the *Colorado River Corridor* - scientific and Southern Paiute versions; comparison of what is learned through archaeology and through oral history
b. Ecology concept within cultural anthropology
c. Prehistoric and historic patterns of resource use within the *Corridor* and surrounding area
d. Present day resource use within the *Corridor* - Native Americans, recreationists, scientist, power production and use, water storage
e. Impact of the dam on evidence of prehistoric and historic human life and on present day resource use

The youth also spent time with the surveyors. They observed and were able to participate in setting up rods, communicating with the total station via radio, and using the total station to locate a target and measure distance. They also took a ride on the boat equipped with hydrology equipment to observe the use of a continuous firing laser as it recorded the shape and depth of

Figure 5.3. Youth observe and record rock art

the river bottom. Additional activities, such as water safety and the history of river running in the Grand Canyon, were added to the schedule to provide a diverse program. Table 5.1 presents the location where Southern Paiute environmental education activities were conducted and the concepts addressed in those activities.

In addition to the group activities, individual youths performed activities that helped them achieve their personal research and study goals. For example, one individual studied plants. He photographed more than a dozen plants that are used by Paiute people. He then recorded the English and Paiute names for those plants. On some occasions he learned the Paiute uses of the plants from an elder on the trip. On others he used the report, *Piapaxa 'uipi* (Stoffle, Halmo, Evans, and Austin 1994), to read what elders had said about the plants during the 1993 ethnobotany study. He shared information about the plants with the entire group.

The environmental education program was designed as a continually developing program where activities were organized to introduce, expand, and reinforce concepts. Although the concepts and some activities had been identified prior to the trip, the actual presentation of these concepts and activities was determined as the trip progressed. This semi-structured program design allowed program leaders to adjust the program to meet the needs of the youth and to interface with the activities of the survey/monitoring program.

Several concepts that were initially included in the environmental education program were not covered during the July 1995 trip or were covered only superficially. For example, topic 2e, relationship between particle size and sediment transport, was introduced through a sedimentation experiment that was begun at Kanab Creek but was never discussed again. Also, although the age of the rocks in the region and of the Grand Canyon were discussed on several occasions, the major geologic periods evident in the study area (topic 2a) were never discussed. These topics were eliminated from the program primarily because the composition of the group changed significantly when the four youth left at Phantom Ranch. The majority of the remaining youth were young (13 or below), so fewer concepts were covered and more time was spent on those that were included in the program. Observations and recommendations related to participant age and experience are provided in the final section of this chapter.

Although the concepts have been listed separately, a key aspect of the environmental education program is the *integration of concepts* through experiential activities, presentations, and discussions. Three topics that illustrate the use of multiple experiences and the incorporation of several concepts are described below.

Table 5.1. Schedule of Environmental Education Activities

Date	Location	Activity(s)	EE Concept
July 5, 1995	Lees Ferry (Mile 0)	Opening Meeting and Prayer	
	Mile 3	Orientation Meeting - youth responsibility for the future	
	Jackass Canyon (Mile 8)	Hike to observe rocks and fossils	2a, 2b
July 6, 1995	South Canyon (Mile 31)	Southern Paiute ceremony; hike to view rockshelters and rock art panels	4a
July 7, 1995	Nankoweap Canyon (Mile 52)	Learn to read compasses, topographic maps, measure water temperature with thermometers; hike to graneries to observe features and compare landforms to maps; hike to ridge with rockshelters with tribal elder to learn how they were used; surveyors' demonstration of "gun" and opportunity to try using it; hike to Little Nankoweap Creek to measure water temperature, compare to temperature in the main river, discuss relationships between organisms and their habitats; hike up Little Colorado River to observe results of recent flash floods, discuss role of vegetation, both on the rim and in the channel, in erosion prevention	2a, 2c, 2g, 3c, 3d, 3f, 4e
	Little Colorado River	Swim, ensure all life jackets are properly fitted and youths are comfortable with their use, experience the forces and actions of riffles, rapids, and eddies in the river	2d, 3f
		Travelling below LCR on the boats - observation and discussion of Salt Mines	2f
		Stop #4 - Lava Canyon	
July 8, 1995	Tanner	Channel formation study; hike to petroglyphs, read Southern Paiute interpretations	2c, 2d, 2g
	Crystal Rapids	Observation of water flow in and around rapids; discussion by boatman about how to run the rapids and why particular routes are chosen or avoided	2d

	Bass Camp	River runner history on the Colorado River	
July 9, 1995	Bedrock Canyon	Visit archaeological site	4a
	Stone Creek	Recreational swim	
	Deer Creek	Paiute history & culture	4a, 4c, 4d
July 10, 1995	Below Pancho's Kitchen	Farming and living in the canyon	4b, 4c
	Kanab Creek	Set up sedimentation study; elder interview about his family history in Kanab Creek; identification of plants used by Southern Paiutes; swim	2e, 3e, 4c
	Vulcan's Anvil	Swimming relays; Paiute games; experiments to study chemical erosion; "Unnatural" hike to test and strengthen observation skills	2c, 4a, 4c, 4e
July 12, 1995	Cave below Lava Falls	Observation and practice setting up surveying rods, using radio; observation of boats running through rapids at Lava Falls	2d
	Whitmore Wash	Study and recording of rock art; presentation about the ghost dance; observation and video recording of tarantual hawk building nest - discussion of animal behavior	3c, 3e, 4a, 4c
July 13, 1995	Whitmore Wash	Identification of plants used by Southern Paiutes, presentation of their Paiute names and uses; plant and animal adaptations to a desert enviroment; visit to a rock shelter	3b, 4c
	Parashant Wash	Review results of chemical erosion experiments begun at Vulcan's Anvil; word games	2c, 2f
	Ompi (Hematite) Cave	Discussion of Paiute culture and sacred traditions and of Paiute relations with other tribes (Note: this discussion was held in the boats because no one was present to prepare the youth to visit this site)	4c, 4d
July 14, 1995		Review of compasses, orienteering activity where youth worked in pairs to create a trail for others to follow; visit to rockshelter	

	Pumpkin Spring	Visit to spring, discussion of the importance of medicine springs in Paiute culture; ride on hydrology boat to observe measurement of depth and shape of the river channel	2c, 2d, 4a, 4c
July 15, 1995		Take Out - Diamond Creek	

Channel Formation and Water Flow

Southern Paiute youth were introduced to the study of channel formation and water flow by swimming in the Little Colorado River. The constant cold temperature of the Colorado River below Glen Canyon Dam precludes much swimming, so time was allotted for an afternoon swim in the Little Colorado River. Everyone began with a life jacket on until he or she could demonstrate the ability to swim unassisted. The youths enjoyed floating down the river through riffles and rapids, and moving upstream in eddies. Youth program leaders and the monitoring staff joined the youth in their swim. No formal instruction occurred; instead, individuals were encouraged to try swimming in various parts of the river and their questions were answered individually as they arose. Even the least strong swimmers were participating fully by the end of the session. In addition to its value as an experience with water flow, this activity is critical for ensuring that youth are wearing their life jackets properly and know how to respond if they were to be thrown into the water. Youth and program leaders also discussed the formation of calcium deposits and their relationship to travertine deposits in the Little Colorado River and elsewhere in the *Colorado River Corridor*. This activity also built upon activities that were done at Nankoweap Creek related to water temperature, the relationship between environmental conditions such as temperature and the presence of aquatic organisms, and the effect of changing environmental conditions such as the dam and upstream floods on the ecosystem.

Formal instruction about channel formation and water flow first occurred on the sandy beach above Tanner Rapid. The wet sand provided an ideal place for the youths to create channels and experiment with channels of various lengths, widths, and shapes. The youth were provided with containers for bringing water to the top of their channels and were shown the effects of changing width on the speed of water flowing through the channels (see Figure 5.4). They were then instructed to work with a partner to create additional channels and observe what happened. Several groups began immediately to create channels with features such as constrictions, s-curves, and debris. Some were initially unable to think of any variables except channel width but, after observing the others, began to add features to their channels. One individual had selected the topic of water flow for her research project. She video taped the various projects as they were created. After each group had created several channels, the individuals were encouraged to gather around the channels that had been made to watch what happened when water flowed through them. The group observed (1) changes in water speed according to channel width and movement around bends, (2) erosional features such as the

Figure 5.4. Youth experiment with channel flow on the beach above Tanner Rapid

movement of headcuts up the channel and undercutting along the outside banks around bends, and (3) the formation and effects of eddies, rapids, and riffles. After finishing their projects, the youth climbed above Tanner Rapid to observe the water flow above, through, and below the rapids.

The study of channel formation and water flow continued as the rafts moved downstream through the long series of rapids that exists below Tanner. Features such as undercutting and eddies were identified from the rafts throughout the trip. Program leaders took advantage of the excitement generated by large rapids and the opportunity to climb out of the river channel to observe them to reinforce concepts that were learned. In addition, the boatmen took the time to explain to the youth how they would run the rapids and why they made the choices they did.

Southern Paiute Life in the Grand Canyon

This activity began at Lees Ferry when the Coordinator of the SPC reviewed the importance of the study area to Southern Paiute people, and it continued throughout the trip while travelling on the river and stopping along its banks. Each survey stop had been selected because it contained cultural resources significant to Southern Paiutes. Therefore, at each stop the specific resources present were identified and discussed. Youth participated in prayers and ceremonies conducted prior to entering certain sites, observed and were told the significance of symbols left on the rocks by their ancestors, and were shown how to use grinding stones and fire sticks. They also heard stories of the interactions between Southern Paiutes and neighboring tribes such as the Hualapai and Havasupai in trading, marriage, and seeking refuge from Euroamerican encroachment. They climbed up to rockshelters and granaries and looked down upon deltas that were the locations of former farming areas to discover how and why people used places in the way they did. They learned about using plants and animals for food, clothing, medicine, and shelter. They learned about the interactions between Paiutes and the first Euroamericans, such as John Wesley Powell, who visited the Grand Canyon and about how non-Indian activities, such as asbestos mining, dam building, and creation of a national park, affected the Paiutes living there.

Landforms, Geology and Maps

Southern Paiute youths were introduced to maps of the Colorado River during the orientation meeting on the first day of the trip. Each youth participant was given a copy of Belknap's (1993) *Grand Canyon River Guide* and shown how to read the guide. Youths were encouraged to use the guide to record events and thoughts that they wanted to link to the places they had seen. Thoughout the trip the youths met to update and review their river guides.

Figure 5.5. A Paiute elder demonstrates how to use a yucca firestarter

Youth participants were formally introduced to topographic maps and compasses at Nankoweap Canyon. One program leader created a hill of sand and then created a topographic map of the hill. Additional features were added to the hill and the map until the youths were familiar with how to read and interpret the map. Each youth participant was given a topographic map of the area located at the intersection of Nankoweap Canyon and the Colorado River. They located various topographic features on their maps. The youths then hiked to the granaries located above the river to view and discuss these structures. While sitting in front of the granaries, the youths again used their maps to locate the river, island, and penninsula that were visible below. The ability to see the entire area from above and to identify features that were in view served as an excellent means of checking their ability to read and interpret the maps. Youth participants observed the surveyors and monitors using maps throughout the trip.

Landforms within the *Colorado River Corridor* are constantly changing due to uplift, volcanic activity, and erosion. Areas of uplift, of lava flows, and of erosional activity were pointed out as the boats floated through the corridor and when the youths were hiking on the shore. The youth conducted several experiments to observe the process of chemical erosion as it occurs in the corridor, using lemon juice and vinegar as weak acids, hydrogen peroxide, salt, and water. They made predictions, gathered their materials, read and followed printed directions, and evaluated their results.

PROGRAM EVALUATION

The initial project development for the SPC Youth Environmental Education Program was successfully completed during FY 1995. In this section, several aspects of the program are evaluated. Throughout the trip, youth and adult participants evaluated activities and provided suggestions for how the trip should be conducted in the future. Their recommendations have been combined with those of the program leaders.

The loss at Phantom Ranch of four youth participants, one educational program leader, and one elder had a major impact on the 1995 river trip. These individuals had made important contributions to the trip, because of their knowledge and their experience, and their presence was sorely missed. Three of the youth participants who left were the oldest youths, three had participated in the program since March, and three had selected to study topics that no other individuals were studying. Such an event is not expected to occur on a future trip, so the effect of that loss is not discussed in the program evaluation.

Program Design

The two-tiered program approach that includes both group and individual activities worked very well. The organization of group activities around four concept areas provided all youth with a broad base upon which to build their knowledge of the *Colorado River Corridor*. The opportunity for the youths to select a research topic allowed each individual to tailor the program to meet his or her needs. Youth participants requested that, in the future, *all* youths who will participate in the river trip should begin participation in the program *at least* four months in advance. The early stages of the program should include both group and individual activities so youth are prepared for the river trip and get the most out of it (see "Pre-River Trip Activities" below). In addition, the youth participants recommended that activities that will build physical stamina and endurance be included from the start so all are physically as well as mentally prepared for the trip.

The flexible program wherein concepts have been determined but multiple activities are possible and can be completed in any of several sequences is necessary for a program that can respond to the varying conditions of a river trip, such as weather, schedule changes, and camp availability. This design requires that at least one youth program leader with experience creating and implementing outdoor educational activities be included in the trip.

The flexible program also made it possible for activities to be tailored to match the ages and skills of trip participants. One-on-one, all of the students were attentive and willing to listen and learn. Even with a four-to-one ratio of youth to adult leaders, program activities could be adjusted to meet participant needs. Nevertheless, the particular circumstances of the eleven-day river trip make it impossible to make significant adjustments to the learning environment. For example, the youth trip must occur at the same time as the monitoring trip. The daily schedule and stops are determined by the tribal monitors, and other activities, such as meals and setting up camp, revolve around the monitoring schedule. Delays are common due to unexpected difficulties reaching a site, equipment failure, and the need for additional work at a site due to environmental changes, flooding, increased tourist visitation, etc. Therefore, unlike a typical youth camp, the daily program schedule is in continous flux. The constant presence of the fast moving river, rockfalls and cliffs, and hot, dry temperatures make the environment potentially dangerous. Younger participants require continual supervision to ensure their safety. Only limited accomodations can be made for youth who do not feel like participating, who need some time alone, and who are having difficulty getting along with others. By the fifth day of the river trip, the three youngest participants began to have difficulty getting up and ready in the morning and joining group activities. The number and type of activities and the length of time spent in any one learning period were reduced. Additional time was allotted for supervised, unstructured activities, games, and swimming. Three individuals suffered from minor illness or injury because they ignored instructions about eating, drinking, and moving on and off the boats.

Because of the harshness of the river environment and the need to limit the number of river trip participants to a maximum of ten individuals, it is recommended that the SPC Youth Environmental Education Program be redesigned to include two phases: (1) a program for 10-15 year olds that includes science and traditional Paiute learning opportunities and several trips up to four days in length; and (2) a program for 16-21 year olds that includes advanced science and traditional Paiute learning opportunities, several pre-river trip excursions, trips to the offices of researchers with experience in the *Colorado River Corridor* and to research libraries, participation in a Colorado River monitoring trip, and the opportunity for participants to receive high school or college credit for their participation in the program.

Program Concepts

The program concepts that are included in the four topic areas provide a sound base for understanding the issues surrounding Southern Paiute participation in the management of the *Colorado River Corridor.* The four topic areas are broad enough that concepts within these topics can be altered and expanded in a multi-year program cycle so youths can participate for many years and have a new program each year. The concepts that were initially chosen for the 1995 river trip were intended for high school students. The program was adapted for the younger participants. All participants were able to understand the concepts presented and demonstrated their understanding when carrying out activities. Youths who had participated in the pre-river trip activities were able to more fully participate in the program than those who had not.

Pre-River Trip Activities

Kaibab Paiute youth participated in pre-river trip activities between April 1995 and June 1995. These activities were important for preparing the youth to participate in the eleven-day river trip. An initial meeting was held to gauge the level of youth interest in the scientific aspects of work in the *Colorado River Corridor.* The youth view the Colorado River as a traditional homeplace, but they are not well acquainted with the connection of science to Southern Paiute traditional knowledge. Significant interest was shown by both the youth and their parents, and eleven individuals enrolled in the program.

To assist the youth link scientific and traditional knowledge, the youth were required to attend additional meetings, workshops, and field trips in preparation for the actual research river trip on the Colorado River. These included a trip to the Bureau of Reclamation/National Park Service Stabilization Workshop, a trip to rock art sites above Lees Ferry, and a trip to House Rock Valley to learn about geology and Southern Paiute history on the Arizona Strip. Each of these trips was successful and provided a unique element to the youth program. The Workshop allowed youth to observe scientific presentations and interact with representatives of agencies and tribes that are involved in the management of Glen Canyon Dam. The trip to Lees Ferry introduced the youth to some of the challenges of cultural resource management below Glen Canyon Dam. The trip to House Rock Valley provided an overview of Southern Paiute history in the region. Although the geology component of that trip had to be cancelled, it should be included in future years. All of these or similar trips should be included in the 1996 educational program.

In addition to the group trips, additional time was spent prior to the river trip providing the youth with background information about the research that has been conducted regarding Southern Paiute cultural resources in the *Colorado River Corridor.* Each student selected a scientific topic to research and used photographs, videos, and written reports to learn about it. This is an important component of the pre-trip program because each student develops specialized knowledge about one topic to share with others and develops a sense of ownership of the entire project.

The early group activities were also critical for building group rapport and establishing expectations and standards of behavior so all participants identify with the group and have a sense of support that enables them to better meet the challenges they will face on the trip. The Shivwits Paiute youth were unable to participate in pre-trip activities because of logistical problems getting the program implemented. These individuals confirmed the importance of the pre-trip activities to the overall success of the program.

River Trip Activities

River trip activities include experiments and lessons that required special equipment prepared prior to the trip, experiments and lessons that required only materials available along the river but were planned prior to the trip, and activities that were designed and planned during the trip. For example, the experiments relating to chemical erosion required lemon juice, pennies, and hydrogen peroxide. The sedimentation and channel formation experiments required only containers, water, sediments, and rocks. In contrast, the "unnatural" walk was suggested by the trip cook during the trip and required only everyday objects that were available in the trip supplies.

The activities that were the most successful were those that took place where the setting and the activity reinforced each other. For example, Nankoweap Canyon is an excellent place to introduce and practice using topographic maps. The hike to the granaries is a natural activity for the youth, and a large stretch of the river that includes various topographic features can be viewed from the granaries. Youth can field test their own ability to read the maps by locating various environmental features on the map while looking down on them. Similarly, the Little Colorado River is an excellent spot for experiencing currents and the variation in water temperature between the dam-controlled Colorado River and other channels. The opportunity for youth to swim in the river also allows program leaders to ensure that all youth know how to swim in their life jackets before they enter the large rapids on the river.

The coordination of the youth and monitoring programs helps ensure that the cultural component of the program receives sufficient attention. Each of the stops offers Southern Paiute youth a new opportunity to see and experience culturally important places. The most effective experiences included participation in Southern Paiute ceremonies or traditions while at the stops. The participation of tribal elders and cultural resource experts is critical for this component of the program.

The geology component of the environmental education program requires additional development and refinement. Activities related to rock types and types of erosion were used in several cases as "filler" projects, so that aspect of the program was the least well coordinated. Also, much of the geology is seen from the rafts while travelling, and the youth were divided among two boats, so there was an uneveness to the presentation of information. A few meetings both before and after trips through geologically interesting sections of the canyon would help youth integrate what they see and experience during the trip.


Figure 5.6. The view from the granaries at Nankoweap

Activities in the biology program component were successful, but there was not enough attention paid to them, and they require greater integration. Topics such as relationships between organisms and their habitats and the effect of changing environmental conditions on ecosystems are crucial to a thorough understanding of the *Colorado River Corridor*. In addition, there are many natural links between ecological concepts and Southern Paiute traditional knowledge, and these need to be more fully developed. Again, this component of the program requires active participation by tribal elders and cultural resource experts.

SUMMARY AND CONCLUSIONS

The SPC youth environmental education program is an important component of Southern Paiute work in the *Colorado River Corridor*. An extensive amount of cultural knowledge has been gathered during the four years of research in the study area. The program is designed to help prepare Southern Paiute youth to participate in decision making and cultural resource monitoring along the Colorado River. It integrates concepts in water use, geology, biology, and anthropology.

In the past, Southern Paiute youth were not coaxed to gain an interest in the sciences. The tribal councils seized the opportunity to involve the youth in scientific study while maintaining and passing on tribal knowledge. Preparing the youth to become aware of the possible intertwinement of cultural and scientific knowledge has also been rewarding to the youth.

This first year was a learning experience for all involved; the education specialist, tribal monitor, and program director created the youth environmental education program for the *Colorado River Corridor* and could not predict how the program would go. Youth participants were between 11 and 16 years old and were all interested in the program and willing and able to learn individually. However, the unique river environment created several difficulties for a group program. Based on the findings of the 1995 program, it is recommended that the program be redesigned to include two phases. Phase One should include 10-15 year olds and involve learning experiences and short field trips that focus on science and traditional Paiute knowledge. Phase Two should include 16-21 year olds and will expand and refine the 1995 progam. Important components of the program are (1) background study and short field trips, (2) a river trip, and (3) reports to the tribes. All Phase Two participants should be included in all three aspects of the program. Background activities should include an introduction to the program concepts and physical endurance training. The river trip should take place simultaneously with the SPC monitoring trip. All youth participants should prepare and give both written and oral reports of their experiences to Southern Paiute government leaders and community members.

The 1995 youth environmental education program has demonstrated that the SPC and Southern Paiute youth are both ready and able to devote time and energy to the development and implementation of an environmental education program. With sufficient resources, the SPC can modify and expand the program begun in 1995 to produce a program that will serve the needs of the youth and the tribes for many years in the future.

CHAPTER SIX

SUMMARY AND RECOMMENDATIONS FOR THE FUTURE

This report concludes the first phase of Southern Paiute research and study in the *Colorado River Corridor*. In this chapter the major findings and recommendations of that work will be reviewed. In addition, the Southern Paiute plan for future work is presented.

The *Colorado River Corridor* is a significant place for Southern Paiutes. The Southern Paiute Consortium (SPC) and the six tribes it represents have invested and will continue to invest time and resources to help ensure that the cultural resources impacted by the Glen Canyon Dam are appropriately managed.

To date, Southern Paiutes have identified cultural resource sites, provided data on the historic and present resource use within the *Colorado River Corridor*, made recommendations about the management of the sites, and begun developing and testing a program to monitor them. The traditional lands of the Southern Paiute people are bounded by more than 600 miles of *Piapaxa* (Colorado River) from the Kaiparowits Plateau in the north to Blythe, California in the south. According to traditional beliefs, Southern Paiute people were created in this traditional land and, through this creation, the Creator gave Paiute people a special supernatural responsibility to protect and manage this land, including its water and other natural resources. Traditionally Southern Paiutes lived, farmed, collected plants, and hunted along the Colorado River where it passed through their land. The banks of the Colorado River are full of culturally meaningful human artifacts and natural elements. When Southern Paiutes were forced away from their farms and hunting lands on the Colorado Plateau, many of them moved into *Piapaxa 'uipi* (Grand Canyon). They were soon forced out of the *Piapaxa 'uipi* as well when control of the region was taken by the U.S. federal government to create a forest preserve, a national monument, and then a national park. Still, they maintain ties to the region; elders remember going into the canyon and recall stories told to them by people who lived in the canyon, and younger tribal members learn about the place through visits and stories.

Southern Paiute Cultural Resources

Southern Paiute cultural resources in the *Colorado River Corridor* include artifacts and signs left by the old ones (archaeology and rock art sites), plants, animals, and traditional cultural properties (TCPs). The meaning and cultural significance of these resources have been described in the first two reports of this series (Stoffle, Halmo, Evans, and Austin 1994, Stoffle et al. 1995) and in Chapter Two of this report. These cultural resources continue to provide meaning to and be used by Southern Paiutes, and the SPC has been given the responsibility of helping to ensure that they will be available to future generations of Paiute people.

Management Recommendations

Since Southern Paiutes began participating in research studies in the *Colorado River Corridor* in 1992, tribal representatives have discussed what they thought should be done to protect traditional sites and resources in the study area. These recommendations have been reported elsewhere (Stoffle, Halmo, Evans, and Austin 1994; Stoffle et al. 1995, Chapter Two of this report) and will not be repeated here. This section will summarize the overall recommendations of the Southern Paiutes regarding the management of the *Colorado River Corridor*. In evaluating and making recommendations about impacts to cultural resources, Southern Paiutes differentiate between natural and human impacts. Therefore, these are discussed separately.

Natural Impacts

Archaeology sites and rock art panels are eroded by rain and wind, plant communities are destroyed by debris flows, and sediments are replenished by floods. These and other natural impacts *cannot* and *should not* be stopped because deterioration and change are part of the natural order of things.

Human Impacts

Human activities accelerate natural impacts and cause new ones. Direct impacts to archaeology sites, rock art panels, and plant and animal communities come from fluctuating water levels and gullying that is unchecked because of a lack of sand in the river system. The SPC supports water flow alternatives that reduce erosion and minimize these impacts. Indirect impacts to cultural resources come primarily from tourists who become concentrated in some places and directed away from others, largely as a result of the presence or absence of beaches. The relationship between water release policies, tourist behavior, and cultural resource sites is complex and must be better understood to protect places of cultural significance.

While further studies are conducted, certain steps should be taken to ensure that places of cultural significance do not suffer from additional damage. These steps are:

(1) Maintain water levels as low as possible and avoid rapid fluctations in water level.

(2) Do not advertise the location of archaeology sites, rock art panels, or traditional cultural properties (TCPs) in displays or brochures.

(3) Restrict access to certain places where there have been impacts from visitors:
the Salt Cave (presently closed to the public)
Ompi (Hematite) Cave
Vulcan's Anvil
Bedrock Canyon Site
Granite Park (provide special protection for the Gooddings Willow there).

(4) Reduce trailing at cultural resource sites by planting cacti or otherwise blocking existing trails.

(5) Educate visitors to the *Colorado River Corridor* that this is an American Indian homeland. American Indian people must be involved in the creation of educational materials and in the education process (see "Visitor and Agency Education" below).

Additional steps directly involve Southern Paiutes and are described in the following section.

Continued Southern Paiute Participation in the Glen Canyon Dam Adaptive Management Program

Clearly, the SPC has a unique place in the overall Glen Canyon Dam Adaptive Management Program and is prepared to move toward increasing co-management resposibilities. Southern Paiutes bring knowledge and experience and intend to continue to develop their expertise and share it in four ways: (1) regular monitoring; (2) Southern Paiute Access and Youth Environmental Education; (3) Visitor and Agency Education; and (4) Research.

Regular Monitoring

Southern Paiutes regard the places within the *Piapaxa 'uipi* with reverence and awe. Tribal members who have visited certain highly sacred places have reacted to these places as Euroamericans might react to the Vatican in Rome, Italy. These individuals have been taught how to behave in such places and have expressed concern that the spiritual and physical condition of these places is being negatively affected by human activities, many which are directly and indirectly caused by Glen Canyon Dam.

In addition to these identified sacred places, Southern Paiutes have knowledge about and are concerned with the plants, animals, rocks, water, and signs of the ancestors that are found within *Piapaxa 'uipi*. These things are alive and respond favorably when Southern Paiutes talk to and interact with them. They are also directly and indirectly impacted by Glen Canyon Dam.

Southern Paiutes recognize that they cannot undo the changes that have been caused by the Dam and that the *Piapaxa 'uipi* will continue to be affected by the Dam. They face a situation their traditional teachings do not directly address. Yet, they know too that the lessons of the old ones can be applied in new ways in modern society. They will continue to return to the *Piapaxa 'uipi*, to monitor the impacts of the Dam, to learn from others working in the canyon, and to share their knowledge in the the Adaptive Management Program of the Dam and the important places downstream of that Dam.

Figure 6.1. Southern Paiute monitor locates the endpoint of a transect and communicates by radio with a surveyor

Southern Paiute monitoring is a complex process. It requires simultaneous monitoring of cultural resources, such as rockshelters, associated plant communities, and traditional cultural properties (TCPs), and of both physical and spiritual impacts. Initial development and field testing of the monitoring program occurred during 1995, but the program will not be fully implemented until 1996. The SPC will provide monitors, cultural resource experts, and persons knowledgeable about ceremonies that must be performed prior to visiting sacred places and about the purpose and use of sacred minerals and plants. The monitors will require training so they can learn and apply both scientific and traditional knowledge as they monitor sites and make management recommendations. The monitors must also develop monitoring materials, participate in monitoring trips and data collection in *Piapaxa 'uipi*, analyze data, and prepare reports and presentations for the Southern Paiute tribes and the agencies involved in the Glen Canyon Dam Adaptive Management Program.

The July 1995 survey trip was used to pre-test some monitoring methods and approaches. Baseline data from previous trips were assimilated and new data were gathered and photographs taken (see Chapter Four). Decisions about which data and photographs will be collected regularly and how often those will be collected must be made prior to implementation of the SPC monitoring program in 1996. The monitoring materials must also be developed before the monitoring trip takes place.

The July 1995 survey trip began the process by which information about places that are of special significance to the Southern Paiutes can be incorporated into the GCES-Geographic Information Systems (GIS) program. Attention must be paid to linking information gained from the GIS to that gained from fieldwork and using that information for research, monitoring, and management. The SPC must have a thorough understanding of the GCES-GIS program and its application to determine the level of effort and resources that should be devoted to a tribal database. At a minimum, SPC monitors will be required to spend time at the GCES to learn about and gain experience with GIS, join a GCES survey and research trip to observe how the information contained within the GIS informs fieldwork activities, and return to the GCES offices to integrate data into the GIS system. Ideally, those activities will all occur prior to the 1996 monitoring trip so the SPC can begin to determine where and how to further incorporate GIS into the monitoring program.

Figure 6.2. Southern Paiute tribal monitor collecting information at an archaeological site

Southern Paiute Access and Youth Environmental Education

In addition to their monitoring program, Southern Paiutes require access to the *Colorado River Corridor* to view cultural resource sites, visit sacred sites for religious and traditional ceremonies, collect plants for medicinal and ceremonial purposes, and collect red paint from the *Ompi* Cave and salt from Salt Cave for traditional religious purposes. In addition, the SPC must continue to educate and prepare generations of Southern Paiutes who will be able to represent their tribes and participate effectively in management decisions. The first phase of environmental education program development occurred during 1995. The 1995 experience demonstrated both the appropriateness of and interest in the program. The program will be modified as necessary so it can continue to meet the needs of tribal members and the SPC research and monitoring program. Program leaders will seek to develop internships for college and university students as well as continue to provide opportunities for high school students to receive academic credit for participation in the program.

Figure 6.3. GCES surveyor teaches Southern Paiute youth how hydrological data are gathered

Visitor and Agency Education

The SPC must continue and expand its efforts to educate both visitors to the *Colorado River Corridor* and the agency representatives with responsibilities for its management. SPC representatives should meet with river runners and agency personnel to discuss the cultural significance of certain sites and plant and animal species that have received little human impact, and their desires to have the locations and information about them kept confidential. SPC representatives should also work with Bureau of Reclamation (BOR) and National Park Service (NPS) personnel to develop tourist orientation lectures and documents that specifically discuss the cultural significance of certain sites and plant and animal species that have received considerable human impact. These lectures and documents should include regulations and education about appropriate behavior.

Research

The SPC must continue to conduct research studies in the *Colorado River Corridor* and to influence the type of research studies that others conduct there. Future SPC studies that are critical to the monitoring and management programs include ethnobotany, ethnofauna, and ethnoarchaeology studies and studies of tourist behavior. The SPC monitoring program has begun at sites recognized by the SPC for their special significance to Southern Paiute people and culture. Those sites were originally selected during the ethnoarchaeology, ethnobotany, rock art, and ethnofauna studies. The extent of those studies was limited by time and resource constraints. For example, during the 1992 ethnoarchaeology study, Southern Paiutes were able to visit only 36 of 50 sites identified by Grand Canyon archaeologists as Pai or Paiute. Likewise, only one ethnobotany study has been conducted to date, during which 21 sites were visited by 13 Southern Paiute representatives. In that study, 68 plants of cultural significance to the Southern Pauites were identified. However, additional studies have identified other plants of cultural significance to Southern Paiutes that grow in the study area. Therefore, new information must continually be incorporated into the SPC monitoring and archival program.

Southern Paiutes have expressed concern about visitor impacts to sites of culturally significant places and things since their first research trip to the *Piapaxa 'uipi* in 1992 (see Stoffle, Halmo, Evans, and Austin 1994, Stoffle et al. 1995, and Chapters Two and Four of this report). Over twenty thousand people visit the *Piapaxa 'uipi* via river trips annually (NPS 1989), and more than fifty thousand people use the river between Glen Canyon Dam and Lees Ferry each year (NPS 1984). Two recent studies have been conducted regarding campsite availability, and these demonstrate the links between Glen Canyon Dam, beaches, and where visitors camp (Kearsley and Warren 1993; SWCA, Inc. 1995). The additional link to cultural resources is illustrated in Figure 6.4.

As shown, Glen Canyon Dam impacts cultural resources directly through water released from the Dam, indirectly as beaches and sand bars erode, and indirectly as visitors become concentrated at remaining beaches. According to the 1991 campsite survey (Kearsley and Warren 1993), 13 of the 18 beaches at or very near the Southern Paiute monitoring sites are primary campsites (see Table 6.1). Six of these campsites can accommodate large groups, six can accommodate medium groups, and one is a small camp. Two of these sites have no camps at or very near them, one has a secondary camp available only in low water, one has a small secondary camp, and one has been closed to camping by the NPS. Given the overall decrease in both number and size of campsites along the Colorado River in the past 20 years, campsites

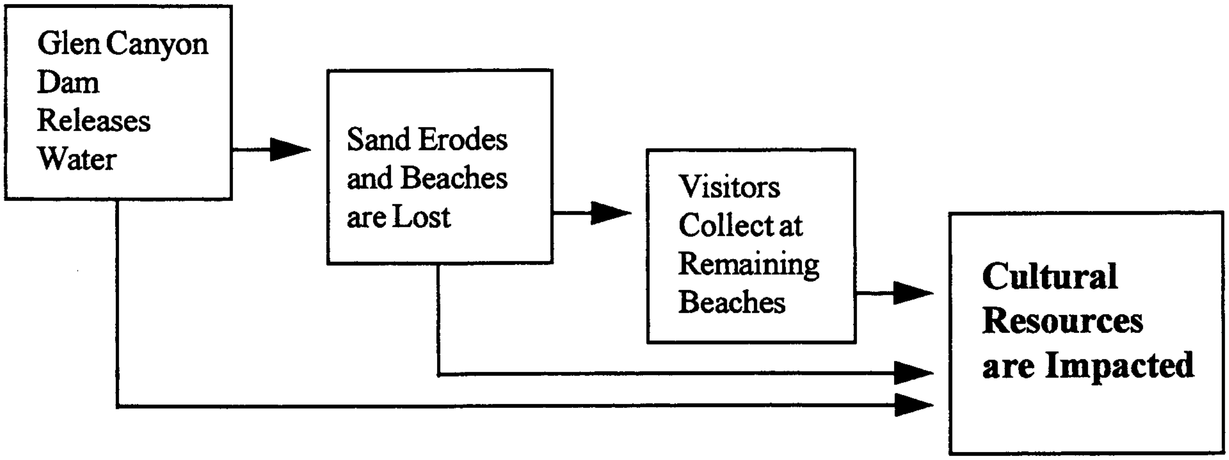


Figure 6.4. Direct and indirect causes of Dam impacts to cultural resources

that still exist receive greater visitor use. Therefore, these places will be likely to continue to experience visitor impacts unless management decisions restrict access to them.

Although campsite presence and use has been studied, no studies have been conducted on visitor behavior at the sites. Understanding visitor behavior, rather than mere presence, is critical to identifying and remediating visitor impacts to the places and the cultural resources found there. Yet, despite some obvious impacts caused by trailing and vandalism to sites, the cause of impacts and potential methods for mitigating them require are poorly understood. The SPC and University of Arizona (UofA) have been involved in studies of tourists and tourist behavior since the 1970s and are well-prepared to undertake such studies within the *Colorado River Corridor*.

CONCLUSIONS

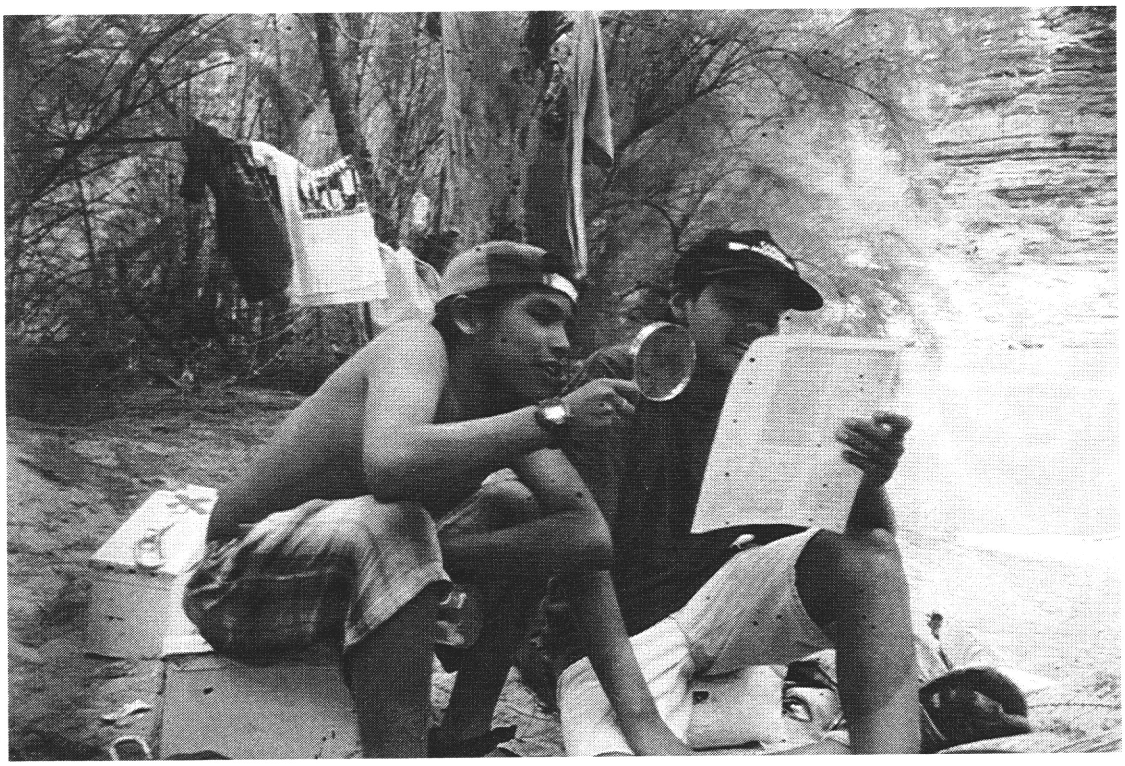
The SPC, on behalf of the Kaibab Paiute Tribe and the Paiute Indian Tribe of Utah, has begun a long term relationship with the BOR to participate in the Glen Canyon Dam Adaptive Management Program. That relationship will require continued effort and investment from both organizations. It can also continue providing benefits to both organizations by broadening the perspectives and understanding of their members. The BOR has and will continue to benefit from the accumulated knowledge of generations of Southern Paiutes who have lived in and used the *Colorado River Corridor*. Southern Paiutes have gained insights into the importance of science and the role it plays with traditional knowledge in research and management. Southern Paiute youth and adults will continue to benefit from opportunities to observe and experience potential

Table 6.1. Presence of and Change in Campsites at Southern Paiute Monitoring Sites (data on campsites taken from Kearsley and Warren 1993)

Site Name	Location	Size*	Type**	Change***
Jackass Canyon	8L	L	primary	none
South Canyon	32R	L	primary	none
Nankoweap	52R	L/L/L	primary	none
Lava-Chuar	65R	closed	closed	loss
Tanner	68R	L	primary	not reported
Bedrock	130L	none	none	
opposite Deer Creek	136L	M	primary	none
below Deer Creek	136L	M	primary	loss
Kanab Creek	143R	S	low water	not reported
above Vulcan's Anvil	178L	M	primary	loss
Vulcan's Anvil	178R	S	secondary	not reported
Whitmore Wash	188R	L	primary	not reported
lower Whitmore Wash	188R	M	primary	loss
above Parashant	198R	none	none	
Hematite Cave	200R	M	primary	loss
below Spring Canyon	204R	M	primary	not reported
Indian Canyon	207R	S	primary	not reported
Pumpkin Spring	213L	L	primary	none

*size: L=large (25-36 people); M=medium (13-24 people); S=small (1-12 people)
**type: primary=destination sites in high use season; secondary=chosen only if no primary site is available
***change: change between 1973, 1983, and 1991 campsite surveys

interrelationships between Southern Paiute culture and science and to see how important these relationships are. The new knowledge and insights will play an important part within both organizations, in the decisions that are made and the actions that are taken.



REFERENCES CITED

Atran, Scott

1990 *Cognitive Foundations of Natural History: Towards an Anthropology of Science*. New York: Cambridge University Press.

Behler, John L. and F. Wayne King

1979 *National Audubon Society Field Guide to North American Reptiles and Amphibians*. New York: Alfred A. Knopf.

Belknap, Buzz and Loie Belknap Evans

1993 *Grand Canyon River Guide*. Evergreen, CO: Westwater Books.

Berlin, Brent

1978 Ethnobiological Classification. In *Cognition and Categorization*. E. Rosch and B. Lloyd, eds. Pp. 9-26. Hillsdale, NJ: Lawrence Erlbaum.

1992 *Ethnobiological Classification: Principles of Categorization of Plants and Animals in Traditional Societies*. Princeton, NJ: Princeton University Press.

Berlin, B., D. Breedlove, and P. Raven

1973 General Principles of Classification and Nomenclature in Folk Biology. *American Anthropologist* 75:214-242.

Bolton, Herbert E.

1950 *Pageant in the Wilderness. The Story of the Escalante Expedition to the Interior Basin, 1776*. Including the Diary and Itinerary of Father Escalante. Salt Lake City: Utah State Historical Society.

Borror, Donald J. and Richard E. White

1970 *A Field Guide to Insects: America north of Mexico*. Boston: Houghton Mifflin Company.

Brewer, Les and Debbie Berrier

1984 *Photographic Techniques for Monitoring Resource Change at Backcountry Sites*. General Technical Report NE-86. Broomall, Pennsylvania: Northeastern Forest Experiment Station, Forest Service, USDA.

Brown, Bryan T., Steven Carothers, and R. Roy Johnson.
1986 *Grand Canyon Birds*. Tucson: The University of Arizona Press.

Burt, William H. and Richard P. Grossenheider.
1976 *A Field Guide to the Mammals: North America north of Mexico*. Boston: Houghton Mifflin Company. Third edition.

Carothers, S.W. and Brian T. Brown
1991 *The Colorado River Through Grand Canyon*. Tucson: University of Arizona Press.

Coder, Christopher, Lisa Leap, Nancy Andrews, Dana Kline, and Duane Hubbard
1994 *Summary Report for 1993 GCES Monitoring of Archaeological Sites from Lees Ferry to Separation Canyon, Grand Canyon National Park*. Prepared for Grand Canyon National Park. February.

Cole, David N.
1987 Effects of Three Seasons of Experimental Trampling on Five Montane Forest Communities and a Grassland in Western Montana. *Biological Conservation* 40:219-244.
1989 *Wilderness Campsite Monitoring Methods: A Sourcebook*. General Technical Report INT-259. Washington, D.C.: Intermountain Research Station, Forest Service, USDA. April.
1992 Modeling Wilderness Campsites: Factors That Influence Amount of Impact. *Environmental Management* 16(2):255-264.

Dangermond, Jack
1991 What is a Geographic Information System (GIS)? In *Geographic Information Systems (GIS) and Mapping: Practices and Standards*. A.I. Johnson, C.B. Pettersson, and J.L. Fulton, eds. Pp. 11-17. Philadelphia: ASTM.

Darrah, William C. (ed.)
1947 Biographical Sketches and Original Documents of the First Powell Expedition of 1869. *Utah Historical Quarterly* 15:1-148.

Davis, Gary E.
1983 Natural Resource Monitoring in Channel Island National Park, California. *Renewable Resource Inventories for Monitoring Changes and Trends: Proceedings of an International Conference*. John F. Bell and Toby Atterbury, eds. Pp. 107-110. Corvallis, OR: College of Forestry, Oregon State University.

Degenhardt, W.G.
1966 A Method of Counting Some Diurnal Ground Lizards of the Genera *Holbrookia* and *Cnemidophorus* with Results from the Big Bend National Park. *American Naturalist* 75:61-100.

Dellenbaugh, F. S.
1906 *Romance of the Colorado River*. New York: G. P. Putnams.

Emerton, James H.
1961 *The Common Spiders of the United States*. New York: Dover Publications.

Euler, Robert C.
1966 Southern Paiute Ethnohistory. *University of Utah Department of Anthropology Anthropological Papers* No. 78. Salt Lake City: University of Utah Press.

Evans, Michael J., Richard W. Stoffle, and Sandra Lee Pinel.
1993 *Petroglyph National Monument Rapid Ethnographic Assessment Project*. Prepared for New Mexico State Historic Preservation Office and Southwest Regional Office, National Park Service. Tucson: Bureau of Applied Research in Anthropology, University of Arizona.

Fairley, Helen C., Peter W. Bungart, Christopher M. Coder, Jim Huffman, Terry L. Samples, and Janet R. Balsom
1994 *The Grand Canyon River Corridor Survey Project: Archaeological Survey along the Colorado River between Glen Canyon Dam and Separation Canyon*. Grand Canyon National Park in Cooperation with Glen Canyon Environmental Studies.

Fletcher, Milford and Denise Sanchez
1994 Etched In Stone: Recovering Native American Rock Art, *GPS World* (October):20-24.

Fowler, Don D. and Catherine S. Fowler (eds.)
1971 *Anthropology of the Numa: John Wesley Powell's Manuscripts on the Numic Peoples of Western North America, 1868-1880*. Smithsonian Contributions to Anthropology No. 14. Washington: Smithsonian Institution Press.

Fowler, Don D. and John F. Matley
1979 *Material Culture of the Numa: The John Wesley Powell Collection, 1867-1880*. Smithsonian Contributions to Anthropology No. 26. Washington: Smithsonian Institution Press.

Givon, Talmy
1992 Personal communication to David L. Shaul, Encuentro Linguistico del Noroeste, Hermosillo, Sonora, Mexico.

Glen Canyon Environmental Studies (GCES)
1994 *Geographic Information System Information Guide and Operating Protocol.* Flagstaff, Arizona: Glen Canyon Environmental Studies. January 14.

Gregory, Herbert E.
1948 Journal of Stephen Vandiver Jones. *Utah Historical Quarterly* 16(1,2,3, and 4):19-174.

Hartley, R., A. W. Vawser, A.R. Smith, and M.A. Johnson
1993 Documenting Rock Art in Dinosaur National Monument. National Park Service. *Midwest Archeological Center Occasional Studies in Anthropology* 29:1-122.

Hastings, J.R. and R.M. Turner
1965 *The Changing Nile: An Ecological Study of Vegetation Change with Time in the Lower Mile of an Arid and Semiarid Region.* Tucson: University of Arizona Press.

Hays, Terence
1982 Utilitarian/Adaptationist Explanations of Folk Biological Classification: Some Cautionary Notes. *Journal of Ethnobiology* 2(1): 89-94.

Hoffmeister, Donald F.
1971 *Mammals of Grand Canyon.* Tucson: University of Arizona Press.

Hoffmeister, Donald Frederik and Durham, Floyd R.
1971 *Mammals of the Arizona Strip including Grand Canyon National Monument.* Flagstaff, Arizona: Northern Arizona Society of Science and Art.

Hunn, E.
1982 The Utilitarian Factor in Folk Biological Classification. *American Anthropologist* 84:830-847.

Johnson, R. Roy
1991 Historic Changes in Vegetation Along the Colorado River in the Grand Canyon. *Colorado River Ecology and Dam Management.* Washington D.C.: National Academy Press.

Kearsley, Lisa and Katherine Warren
1993 *River Campsites in Grand Canyon National Park: Inventory and Effects of Discharge on Campsite Size and Availability.* National Park Service in cooperation with the Glen Canyon Environmental Studies. May.

Kelly, Isabel
1964 *Southern Paiute Ethnography.* Salt Lake City: University of Utah Press.

Laird, Carobeth
1976 *The Chemehuevis*. Banning, CA: Malki Museum Inc., Morongo Indian Reservation.

Lambert, David
1989 *Conserving Australian Rock Art: A Manual for Site Managers*. G. K. Ward, ed. The Institute Report Series. Canberra: Aboriginal Studies Press.

Lesica, Peter
1993 Using Plant Community Diversity in Reserve Design for Pothole Prairie on the Blackfeet Indian Reservation, Montana, USA. *Biological Conservation* 65:69-75.

Liddle, M.J
1973 The Effects of Trampling and Vehicles on Natural Vegetation. PhD thesis. Aberdeen, Scotland: University of Aberdeen.

Loendorf, Lawrence, Linda Olson, and Stuart Conner
1993 *A Recording Manual for Rock Art*. Occasional Papers Number 4. Denver, Colorado: Interagency Archeological Services, National Park Service.

Magurran, A.E.
1988 *Ecological Diversity and its Measurement*. Princeton, NJ: Princeton University Press.

Martineau, LaVan
1992 *Southern Paiutes: Legends Lore Language and Lineage*. Las Vegas, NV: KC Publications.

Merriam, C. Hart
1979 *Indian Natives for Plants and Animals Among Californian and other Western North American Tribes*. Socorro, New Mexico: Ballena Press.

Miller, Donald M., Robert A. Young, Thomas W. Gatlin, and John A. Richardson
1982 *Amphibians and Reptiles of the Grand Canyon National Park*. Monograph #4. Flagstaff, AZ: Grand Canyon National History Association.

Miller, Wick R.
1992 Personal communication to David L. Shaul, Encuentro Linguistico del Noroeste, Hermosillo, Sonora, Mexico.

Minckley, W.L.
1991 Native Fishes of the Grand Canyon Region: An Obituary? In *Colorado River Ecology and Dam Management*. Proceedings of a Symposium May 24-25, 1990, Santa Fe, New Mexico. Pp.124-177. Washington, D.C.: National Academy Press.

Mueller-Dombois, D., and H. Ellenberg
1974 *Aims and Methods of Vegetation Ecology*. Pp. 90-92. New York: John Wiley & Sons.

National Park Service (NPS)
1984 *Lees Ferry Upriver Recreation Plan and Environmental Assessment* (Draft). Glen Canyon Recreation Area, National Park Service, USDI.
1989 *Colorado River Management Plan*. Grand Canyon National Park, National Park Service, USDI.

Norton, B.G.
1987 *Why Preserve Natural Variety?* Princeton, NJ: Princeton University Press.

Palmer, William R.
1978 *Why the North Star Stands Still and Other Indian Legends*. Springdale, UT: Zion Natural History Association, Zion National Park.

Parker, Patricia L. and Thomas F. King
1990 *Guidelines for Evaluating and Documenting Traditional Cultural Properties*. National Register Bulletin 38. Washington, D.C.: Interagency Resources Division, National Park Service, USDI.

Payne, N.F. and Fred Bryant
1994 *Techniques for Wildlife Habitat Management of Uplands*. New York: McGraw-Hill.

Peterson, Roger T.
1969 *A Field Guide to Western Birds*. Boston: Houghton Mifflin.

Phillips, Barbara G., Arthur M. Phillips, III, and Marilyn Ann Schmidt Bernzott
1987 *Annotated Checklist of Vascular Plants of Grand Canyon National Park*. Monograph #7. Flagstaff, Arizona: Grand Canyon Natural History Association.

Powell, John Wesley
1895 *Canyons of the Colorado*. Meadville, PA: Flood and Vincent.

Prince, Eugene R.
1988 Photography for Discovery and Scale by Superimposing Old Photographs on the Present-day Scene. *Antiquity* 62:112-116.

Pucherelli, M.J.
1988 Evaluation of Riparian Vegetation Trends in the Grand Canyon Using Multitemporal Remote Sensing Techniques. In *USDI, Glen Canyon Environmental*

Studies: Executive Summaries of Technical Reports. Pp.217-228. Salt Lake City, Utah: Bureau of Reclamation.

Rogers, Garry F.
1982 *Then & Now: A Photographic History of Vegetation Change in the Central Great Basin Desert*. Salt Lake City: University of Utah Press.

Sapir, Edward
1910 *Kaibab Paiute Linguistic and Ethnologic Field Notes*. No. 30 (v.3). Freeman No. 2643. American Philosophical Library, Philadelphia.

Sapir, Edward
1931 Southern Paiute Dictionary. *Proceedings of the American Academy of Arts and Sciences* 65(3):535-730.

Stevens, Larry
1983 *The Colorado River in Grand Canyon: A Guide*. Flagstaff, Arizona: Red Lake Books.

Stoffle, Richard W. and Henry F. Dobyns
1982 *Puaxant Tuvip: Utah Indians Comment on the Intermountain Power Project, Utah Section of Intermountain-Adelanto Bipole I Proposal*. Kenosha, Wisconsin: Applied Urban Field School, University of Wisconsin-Parkside.

Stoffle, Richard, David Halmo, Michael Evans and Diane Austin
1994 *Piapaxa 'Uipi (Big River Canyon)*. Prepared for the National Park Service. Project No. GLCA-R92-0071. Tucson: Bureau of Applied Research in Anthropology, University of Arizona. June.

Stoffle, Richard W., Kristine L. Jones and Henry F. Dobyns.
1995 Direct European Immigrant Transmission of Old World Pathogens to Numic Indians During the Nineteenth Century. *American Indian Quarterly* 19(2):1-22.

Stoffle, Richard, Lawrence Loendorf, Diane Austin, David Halmo, Angelita Bulletts, and Brian Fulfrost
1995 *Tumpituxwinap (Storied Rocks): Southern Paiute Rock Art in the Colorado River Corridor*. Prepared for Southern Paiute Consortium under Cooperative Agreement with the Bureau of Reclamation. Cooperative Agreement #4-FC-40-15260. Tucson: Bureau of Applied Research in Anthropology, University of Arizona. September.

Sutton, Imre (ed.)
1985 *Irredeemable America: The Indians' Estate and Land Claims*. Albuquerque: University of New Mexico Press.

Sun, Dan and Michael Liddle
1993 A Survey of Trampling Effects on Vegetation and Soil in Eight Tropical and Subtropical Sites. *Environmental Management* 17(4): 497-510.

SWCA, Inc.
1995 *Hualapai Recreation Studies: Final Report*. Prepared for the Hualapai Tribe. February.

Turner, Raymond
1980 *Recent Vegetation Changes Along the Colorado River between Glen Canyon Dam and Lake Mead, Arizona*. Prepared for the Geological Survey, USDI. Washington, D.C: Government Printing Office.

United States House of Representatives
1856 *Reports of Explorations and Surveys to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean of 1853-4*. U.S. House Exec. Doc. 91. 33d Congress, 3d Session, Vol. 7. Washington, D.C.: A.O.P. Nicholson.

Walt, Henry, and John Brayer
1994 *A Petroglyph Recording Demonstration Project for Petroglyph National Monument*. Prepared for the National Park Service. July.

Waring, Gwen
1994 *Evaluation of the Current and Historical Riparian Vegetation Trends in Grand Canyon using Multitemporal Remote Sensing Analyses at the Geographic Information System Long Term Monitoring Study Sites*. Technical Report Prepared for Glen Canyon Environmental Studies, Bureau of Reclamation.

Webb, Robert H., Spence S. Smith, and V. Alexander McCord
1992 *Historic Channel Change of Kanab Creek, Southern Utah and Northern Arizona*. Monograph No. 9. Flagstaff, AZ: Grand Canyon Natural History Association.

Wegner, Dave
1991 A Brief History of the Glen Canyon Environmental Studies. In *Colorado River Ecology and Dam Management*. Proceedings of a Symposium May 24-25, 1990, Santa Fe, New Mexico. Pp.226-238. Washington, D.C.: National Academy Press.

Wegner, Dave
1993 Good Luck, Bad Taste. *The News: The Journal of Grand Canyon River Guides, Inc.* 6(2):13.

Werth, Lee F., Patrick J. Wright, Michael J. Pucherelli, David L. Wegner, and Diana N. Kimberling

1993 *Developing a Geographic Information System for Resource Monitoring on the Colorado River in the Grand Canyon*. NTIS Report R-93-20. Washington, D.C.: Applied Sciences Branch, Bureau of Reclamation, USDI. September.

Whitaker, R.H.

1975 *Communities and Ecosystems*. New York: Macmillan.

APPENDICES

APPENDIX A

ANIMALS FOR COLORADO RIVER CORRIDOR ETHNOFAUNAL STUDY

ANIMALS FOR *COLORADO RIVER CORRIDOR* ETHNOFAUNAL STUDY

MAMMALS

Ungulates and Carnivores

M1 Pronghorn Antelope (*Antilocapra americana*)
M2 Collared Peccary (*Pecari angulatus*)
M3 Mule Deer (*Odocoileus hemionus*)
M4 Desert Bighorn Sheep (*Ovis canadensis*)
M5 Badger (*Taxidea taxus*)
M6 Coyote (*Canis latrans*)
M7 Gray Fox (*Urocyon cinereoargentatus*)
M8 Ringtail (*Bassariscus astutus*)
M9 Raccoon (*Procyon lotor*)
M10 Western Spotted Skunk (*Spilogale gracilis*)
M11 River Otter (*Lutra canadensis sonora*)
M12 Mountain Lion (*Felis concolor*)
M13 Bobcat (*Lynx rufus*)
M14 Wolf (*Canis lupus*)

Rodents and Others

M15 Spotted Ground Squirrel (*Spermophilus spilosoma*)
M16 White-tailed Antelope Squirrel (*Ammospermophilus leucurus*)
M17 Cliff chipmunk (*Eutamias dorsalis*)
M18 Rock Pocket Mouse (*Perognathus intermedius*)
M19 Prairie Dog (*Cynomys gunnisoni*)
M20 Beaver (*Castor candensis*)
M21 Canyon Mouse (*Peromyscus crinitus*)
M22 Cactus Mouse (*Peromyscus eremicus*)
M23 White-throated Woodrat (*Neotoma albigula*)
M24 Desert Woodrat (*Neotoma lepida*)
M25 Muskrat (*Ondatra zibethica*)
M26 Desert Cottontail (*Sylvilagus audubonii*)
M27 Black-tailed Jack Rabbit (*Lepus californicus*)
M28 Western Pipistrelle (*Pipistrellus hesperus*)

REPTILES

Lizards

R1 Banded Gecko (*Coleonyx variegatus*)
R2 Gila Monster (*Heloderma suspectum*)
R3 Side-blotched Lizard (*Uta stansburiana*)
R4 Western Whiptail (*Cnemidophorus tigris*)
R5 Yellow-backed Spiny Lizard (*Sceloporus magister*)
R6 Chuckwalla (*Sauromalus obesus*)
R7 Black Collared Lizard (*Crotaphytus bicinctores*)

Snakes

R8 California Kingsnake (*Lampropeltus getulus*)
R9 Grand Canyon Rattlesnake (*Crotalus viridis abyssus*)
R10 Western Diamondback Rattlesnake (*Crotalus atrox*)

AMPHIBIANS

A1 Red-spotted Toad (*Bufo punctatus*)
A2 Leopard Frog (*Rana pipiens*)

BIRDS

B1 Turkey Vulture (*Cathartes aura*)
B2 Red-tailed Hawk (*Buteo jamaicensis*)
B3 Golden Eagle (*Aquila chrysaetos*)
B4 Bald Eagle (*Haliaeetus leucocephalus*)
B5 Peregrine Falcon (*Falco peregrinus*)
B6 American Kestrel (*Falco sparverius*)
B7 Mourning Dove (*Zenaida macroura*)

B8 White-throated Swift (*Aeronautes saxatalis*)
B9 Black-chinned Hummingbird (*Archilochus alexandri*)
B10 Common Raven (*Corvus corax*)
B11 Cactus Wren (*Campylorhunchus brunneicapillus*)
B12 Indigo Bunting (*Passerinea cyanea*)
B13 House Finch (*Carpodacus mexicanus*)
B14 Black-throated Sparrow (*Amphispiza bilineata*)
B15 Northern Mockingbird (*Mimus polyglottos*)
B16 Ring-billed Gull (*Lars delawarensis*)
B17 Scrub Jay (*Aphelocoma coerulescens*)
B18 Lesser Nighthawk (*Chordeiles acutipennis*)
B19 Great Horned Owl (*Bubo virginianus*)
B20 Burrowing Owl (*Athene cunicularia*)
B21 Loggerhead Shrike (*Lanius ludovicianus*)
B22 Wild Turkey (*Meleagris gallopavo*)
B23 Gambel's Quail (*Callipepla gambelii*)
B24 Southwest Willow Flycatcher (*Empidonax traillii*)

FISH
F1 Humpback Chub (*Gila cypha*)
F2 Bonytail Chub (*Gila elegans*)
F3 Colorado Squawfish (*Ptychocheilus lucius*)
F4 Razorback Sucker (*Xyrauchen texanus*)
F5 Rainbow Trout (*Salmo gairdneri*)
F6 Carp (*Cyprinodon carpio*)
F7 Speckled Dace (*Rhinichtys osculus*)
F8 Brook Trout (*Salvelinus fontinalis*)
F9 Sucker (*Catostomus*)
F10 Fathead Minnow (*Pimephales promelas*)

INVERTEBRATES
I1 Tarantula
I2 Black-widow Spider
I3 Straw-colored Bark Scorpion (*Centruroides exilicauda*)
I4 Velvet Ant
I5 Desert millipede (*Orthoporus sp.*)
I6 Harvester Ant
I7 Fly
I8 Stink Beetle
I9 Louse
I10 Kanab Amber Snail
I11 Mosquito

APPENDIX B

1995 ETHNOBIOLOGY-ANIMALS INTERVIEW FORM

1995 ETHNOBIOLOGY-ANIMALS

COLORADO RIVER CORRIDOR CULTURAL RESOURCE ASSESSMENT STUDY
SOUTHERN PAIUTE CONSORTIUM/UNIVERSITY OF ARIZONA

1. Interview #:__________

Date:______________

Interviewer:____________

2. Respondent's Name: ____________________________

3a. Tribe: ____________________ 3b. Ethnic Group:___________________

4. Gender: (Circle) *1 = M* *2 = F*

5.ANIMAL SPECIMEN: A) Common Name B) Indian Name C) Scientific Name

6a. Study Area Site:_____________________

6b. Ecosystem:_____________________

6c. Ecozone Location:	6d. Topography:	6e: Main Water Source:	6f. River Mile___________
i. canyon wall	i. delta	i. River edge	
ii. UDSZ-desert	ii. side canyon	ii. River flood	
iii. OHWS-old riparian	iii. wash or drain	iii. Side stream	
iv. REPS-new riparian		iv. Spring	
v. side canyon riparian		v. Rainfall	

ETHNIC GROUP USE HISTORY: PAST AND PRESENT

7. Did (respondent's ethnic group) traditionally use this animal? (Circle) *1 = Yes* *2 = No* *8 = DK* *9 = NR*

8. What was this animal used for? (CIRCLE BELOW)

1 = Food *2 = Medicine* *3 = Ritual / Ceremony* *4 = Clothing* *5=Tools(Bone)* *6=Other (SPECIFY)* *8=DK* *9=NR*

9. Who used this animal most often? *1 = Men* *2 = Women* *3 = Both* *8=DK* *9=NR*

10. Do (respondent's ethnic group) currently use this animal? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

11. (If yes) What is this animal used for? CIRCLE BELOW

1 = Food *2 = Medicine* *3 = Ritual / Ceremony* *4 = Clothing* *5 = Tools(Bone)* *6 = Other (SPECIFY)* *8=DK* *9=NR*

12. Who uses this animal most often? *1 = Men* *2 = Women* *3 = Both* *8 = DK* *9 = NR*

<u>PERSONAL USE HISTORY: PAST AND PRESENT</u>

13. Did you (or your family) traditionally use this animal? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

14. (If yes) What was this animal used for? CIRCLE BELOW

1 = Food *2 = Medicine* *3 = Ritual / Ceremony* *4 = Clothing* *5 = Tools(Bone)* *6 = Other (SPECIFY)* *8=DK* *9=NR*

15. Do you (or your family) currently use this animal? *1 = Yes* *2 = No* *8 = DK* *9 =NR*

16. (If yes) What is this animal used for? CIRCLE BELOW

1 = Food *2 = Medicine* *3 = Ritual / Ceremony* *4 = Clothing* *5 = Tools* *6 = Other* *8=DK* *9=NR*

<u>OTHER SIGNIFICANCE:</u>

17a. Are there Paiute stories and legends associated with this animal? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

17b. Are any of those stories and legends associated with this animal being here in the Grand Canyon? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

CULTURAL TRANSMISSION

18. From whom did you learn about this animal? CIRCLE BELOW

1 = Mother *2 = Father* *3 = Grandmother* *4 = Grandfather* *5 = Other Relative (SPECIFY)* *6 = Friend, Neighbor, Other Person*

7 = Other (Signify) *8 = DK* *9 = NR*

19. Have you ever taught anyone about this particular animal? *1 = Yes* *2 = No* *8=DK* *9 = NR*

20. (IF YES) Who have you taught?

1=Children *2=Grandchildren* *3=Other Relative (Specify)* *4=Friend, Neighbor* *5=So. Paiute Youth* *8=DK* *9=NR*

21. What about this animal were you teaching to that person? (CIRCLE BELOW)

1 = Food *2 = Medicine* *3 = Ritual / Ceremony* *4 = Clothing* *5 = Tools* *6 = Stories/Legends* *7 = Other* *8=DK* *9 = NR*

22. Are you currently teaching anyone about this particular animal? *1 = Yes* *2 = No* *8=DK* *9 = NR*

23. (IF YES TO #22) Whom are you teaching?

1=Children *2=Grandchildren* *3=Other Relative (Specify)* *4=Friend, Neighbor* *5=So. Paiute Youth* *8=DK* *9=NR*

24. What about this animal are you teaching/will you teach to that person? (CIRCLE BELOW)

1 = Food *2 = Medicine* *3 = Ritual / Ceremony* *4 = Clothing* *5 = Tools* *6 = Stories/Legends* *7 = Other* *8=DK* *9 = NR*

ANIMAL PART(S) USED

25. What are the parts of this animal used for/ how are these parts prepared?

(INTERVIEWER: WHEN ASKING QUESTION, SPECIFY PARTS FIRST, THEN USES FOR EACH ONE)

PARTS USED	*FOOD*	*MEDI-CINE*	*CERE-MONY*	*CLO-THING*	*TOOLS*	*OTHER*	EATEN RAW	MASH/ GRIND	BOIL	FRY	ROAST	DRY	TAN-NING	OTHER	COMMENTS
a.MEAT															
b.SKIN/HIDE/ FUR															
c.BONES															
d.FEATHERS															
e.CLAWS															
f.SHELL															
g.TEETH															
h.FEET															
i.TAIL															
j.HORNS															
k.ANTLERS															
l.BEAK															
m.RATTLE															
n.BLOOD															
o.OIL/FAT															
p.SINEW															
q.FECES															
r.INTERNAL ORGANS															
s.OTHER (SPECIFY)															

26. When do you gather this animal?

27a. How do you harvest the animal?

1 = hunt *2 = trap* *3 = gather* *4 = other (SPECIFY)* *8 = DK* *9 = NR*

27b. (If harvested separately from the animal,) How do you get the parts you've mentioned?

1 = gather *2 = purchase* *3 = trade* *4 = other (SPECIFY)* *8 = DK* *9 = NR*

<u>MANAGEMENT TECHNIQUES</u>

28a. Do you (or other Paiute people) try to affect how many of these animals there are? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

28b. (IF YES) What do you (or they) do?

29a. Should anyone do anything here in the Grand Canyon to affect how many of these animals are here? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

29b. (IF YES) What should they do?

30. Where do you find this animal most frequently?

30a. In the *Colorado River Corridor*:

30b. Outside the *Colorado River Corridor*:

31a. Are there any particular plants that usually grow in places where this animal is found? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

31b. What plants are those?

32. What do you see that tells you this animal lives or visits here?

1 = See animal *2 = See tracks* *3 = See nest, den, burrow* *4 = Other (SPECIFY)* *5 = Nothing* *8 = DK* *9 = NR*

33. Would this animal be found here every year during the same season? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

34. How important is this animal to Southern Paiute people? *1 = High* *2 = Medium* *3 = Low* *8 = DK* *9 = NR*

35a. How would you evaluate the condition of this animal's habitat here?

1 = Excellent *2 = Good* *3 = Fair* *4 = Poor* *5 = Very poor* *8 = DK* *9 = NR*

35b. What is it about the condition of this habitat that led you to make that evaluation?

36a. Do you feel there are any human activities affecting the condition of the animal or its habitat here? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

36b. What human activities are affecting the condition of the animal or its habitat here?

37. What would be your recommendation (if any) for protecting the animal or its habitat here from human activities?

38a. Do you feel there are any natural elements affecting the condition of the animal or its habitat here? *1 = Yes* *2 = No* *8 = DK* *9 = NR*

38b. What natural elements are affecting the condition of the animal or its habitat here?

39. What would be your recommendation (if any) for protecting the animal or its habitat here from natural elements?

ADDITIONAL NOTES:

APPENDIX C

LOCATION OF LONG-TERM MONITORING SITES

A GCES-GIS work group that included federal and state agency representatives, Native Americans, and members of other groups identified 15 sites that would be the focus of the long range monitoring plan, special studies, and the archive. The locations of these Long-Term Monitoring Sites are shown on the map.

Glen Canyon Environmental Studies

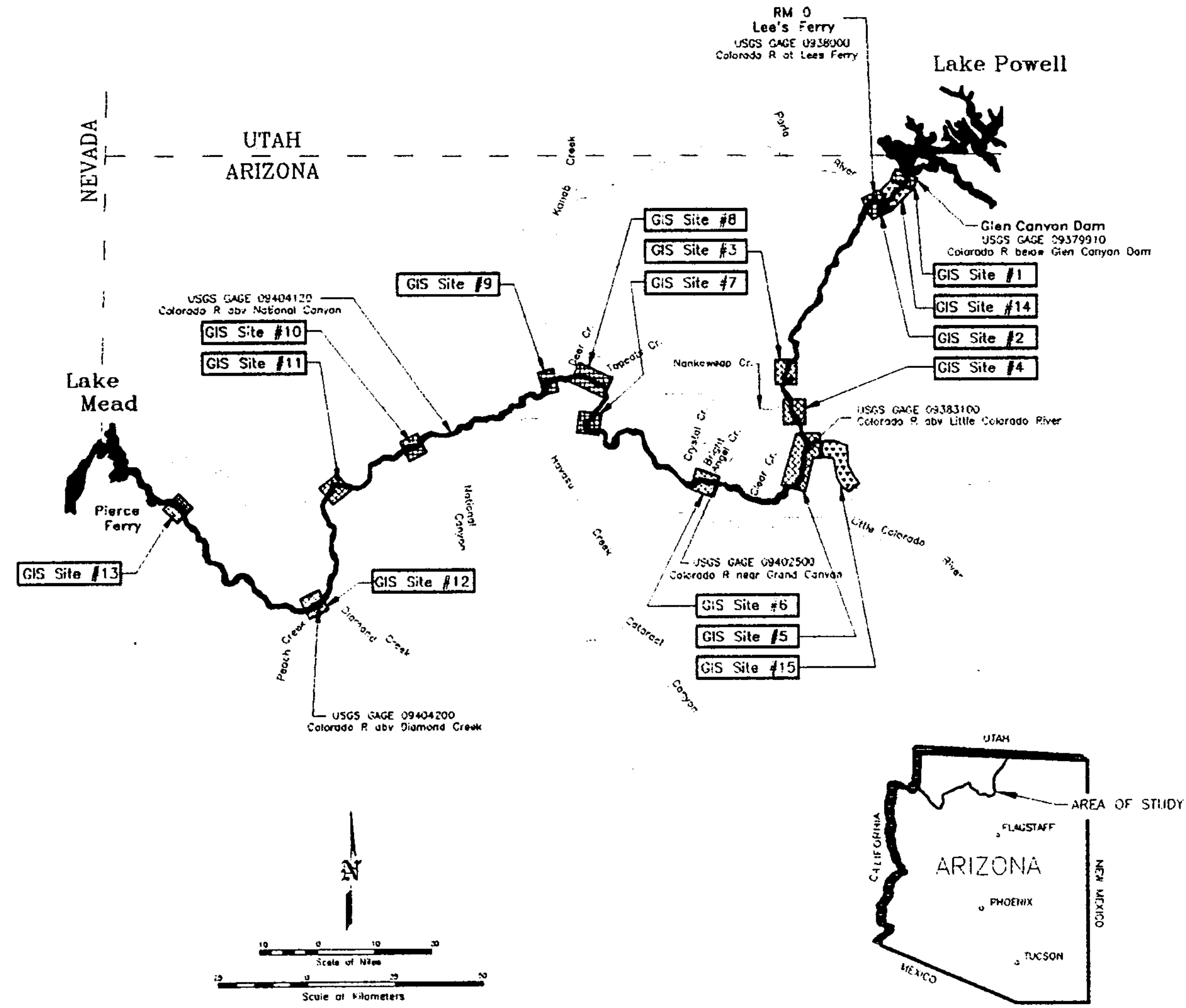
Location of Long-Term Monitoring Sites

Long-Term Monitoring Sites

SITE	LOCATION	RIVER MILE
1	GLEN CANYON DAM	DAM to -10.5
2	LEE'S FERRY	-4 to 2
3	PRESIDENT HARDING	42 to 48
4	NANKOWEAP	51 to 56
5	LCR to CARDENAS	60 to 72
6	GRANITE to CRYSTAL	93 to 99
7	BLACKTAIL	120 to 123
8	TAPEATS & DEER CREEK	133 to 138
9	KANAB CREEK	143 to 145
10	LAVA FALLS	179 to 181
11	GRANITE PARK	207 to 210
12	DIAMOND CREEK	225 to 230
13	COLUMBINE FALLS	273 to 276

Special Study Sites

SITE	LOCATION	RIVER MILE
14	HIDDEN SLOUGH	-10.4 to -4.1
15	LCR	LCR 1.5 to LCR 12
16	To Be Announced	



Legend

- Location of Geographic Information and Long-Term Monitoring Sites
- Special Study Sites
- Colorado River Corridor
- Grand Canyon National Park
- Tributaries
- State Borders

APPENDIX D

GRAND CANYON NATIONAL PARK ARCHAEOLOGICAL SITE MONITORING FORM

10/94

Grand Canyon National Park

RIVER CORRIDOR ARCHAEOLOGICAL SITE MONITORING FORM

MANAGEMENT

1. Site Number AZ: ______________ 2. Monitor Session ______________

3. River Mile _______ Bank (L/R/B): _____ 4. Date ______________________

5. Monitor (s) ____

6. Site Type ____

NATURAL IMPACTS

0 = Absent; 1 = Present; 2 = Increase; 3 = Decrease; 4 = NA (for items 7 - 14)

		Structures / Storage	Artifacts	Roasters/ Hearths	Perishables/ Midden	Rock Art	Other
7.	Surface Erosion (0-10cm)						
8.	Gullying (10-100cm)						
9.	Arroyo Cutting (>1m)						
10.	Bank Slumpage						
11.	Eolian/Alluvial Erosion/Deposition						
12.	Side Canyon Erosion						
13.	Animal-Caused Erosion (trailing,burrowing)						
14.	Other Natural Impacts (spalling, roots)						

15. If arroyos or gullies are present, do they drain to the river? (Note: Some drainages die out in dune fields or on terraces before reaching the river.) 0 = no; 1 = yes; 2 = NA ______________

16. Do any of the above impacts appear to have occurred since the last monitoring episode? 0=no; 1=yes
If yes, explain in 17. ______________

17. Comments:

HUMAN IMPACTS

Site Number :
Monitor Session :

0 = Absent; 1 = Present; 2 = Increase; 3 = Decrease; 4 = NA (for items 18 - 24)

18.

	Structures / Storage	Artifacts	Roasters/ Hearths	Perishables/ Midden	Rock Art	Other
Visitor Impacts						

19. Collection Piles: If present, explain in 26. ________
20. Trails: If present, explain in 26. ________
21. On-site Camping: If present, explain in 26. ________
22. Criminal vandalism/ARPA violations: If present, explain in 26. ________
23. Other: If present, explain in 26. ________
24. Human impacts since last monitoring: ________
25. Are any human impacts directly related to river fluctuations and/or dam operations? 0 = no; 1 =yes If yes, explain in 26 (i.e., development of new trails to avoid high water, availability of new beaches in proximity of site). ________
26. Comments:

MANAGEMENT ASSESSMENT AND RECOMMENDATION

27. Monitor Schedule: 1) discontinue 2) semiannually 3) annually 4) every-other-year 5) every three to five years ________
28. Monitor with a stationary camera: 0 = no; 1 = yes ________
29. Recommended measures to reduce site impacts: 0 = no; 1 = yes

Retrail _____ Plant vegetation _____ Stabilize _____
Obliterate trail(s) _____ Install check dams _____ Close site to visitors _____

30. Recommended measures to protect the site's integrity: 0 = no; 1 = yes

Surface collect entire site ________ Test for depth of subsurface cultural deposits________
Map as a form of data recovery ________ Excavate entire site ________

31. Comments: (i.e., surface sample unit)

APPENDIX E

GCES SURVEY PROTOCOL
CONTROL SURVEY SPECIFICATIONS

GCES SURVEY PROTOCOL 1-15-91

CONTROL SURVEY SPECIFICATIONS

A. RECORDING DATA

1. All notes and information will be recorded in a bound field book with pencil. Notes will never be erased for any reason. If an error is made a single line will be drawn through the error.

2. The following information will be recorded for every control survey:

a. Identification of site, mile marker, left or right of river, and a sketch map with a north arrow orientation.

b. Date, time, and weather conditions such as precipitation, wind, overcast, and visibility.

c. Names and duties of all personnel on the survey.

d. Serial numbers and description of all instruments.

e. Physical descriptions of all benchmarks, backsights, occupied points, located points, and set or staked points. Also include a measurement and description of monuments or points and their relationship above, below, or equal to natural ground elevation.

f. Measurements of instrument height, target height, and any time they change during the survey. These measurements will be measured in meters and in feet.

g. Temperature, barometric pressure, and calculated PPM.

h. Prism constants may also be recorded.

3. Photo documentation is to be maintained on all benchmarks, backsights, and any other control point used.

B. ANGULAR MEASUREMENTS

1. Horizontal angles shall be repeated direct and reverse for as many sets as needed to achieve the desired accuracy established for the survey.

2. Vertical angles shall be turned direct and reverse and checked by their sum totaling 360 degrees.

C. DISTANCE MEASUREMENTS

1. EDM distance measurements shall be taken in meters and in feet. Repeat measurements shall be taken as needed to achieve the desired accuracy established for the survey.

D. GLOBAL POSITIONING SYSTEM (GPS) PROCEDURE

1. If reliable control points do not exist, 2 GPS control points will be established for feature location or beginning of traverse. (1 point for set-up and 1 point for backsight).

2. If reliable control points do not exist, 2 GPS control points will be established for traverse closure. (2 points for verification of azimuth orientation).

3. GPS will be used to verify and\or correct control points of unknown origin or uncertain accuracy.

4. GPS will be used to establish control in remote areas where no other control is available or conditions such as difficult terrain make conventional survey methods inefficient. These remote control points will be checked with a solar observation using the hour\angle method to verify GPS orientation.

5. GPS will be combined with conventional survey methods to best utilize valuable crew time and achieve as high an accuracy as possible with our equipment and protocol.

GCES SURVEY PROTOCOL 1-15-91

EQUIPMENT MAINTENANCE AND CALIBRATION

A. TOTAL STATION

1. Tribrach and optical plummet are checked and adjusted according to procedure specified in owners manual.

2. Two sets of angles, including direct and reverse, are turned from a backsight to a foresight. The first set are backsight with zero and the second set are backsight with a random angle. This procedure will determine that the level, plate, and reticle culmination are all in proper adjustment.

3. Two angles are turned to "close the horizon" to verify that the horizontal circle is in proper adjustment.

4. The vertical circle is manually indexed and checked by the addition of the direct and reverse vertical angles totaling 360 degrees.

5. EDM distance measurements are checked on an established baseline. Distances are measured in meters and in feet. Distance measurements to backsights in the field are checked and compared to previous surveys. Prism constants, PPM calibrations, and power supplies are also checked and adjusted according to specifications in the owners manual.

6. If the Total Station does not preform to the acceptable specifications of the owners manual after all of the above tests are preformed, the instrument will be sent for repair and\or adjustment by the manufacturer or an authorized dealer.

B. FIELD EQUIPMENT

1. The level bubble on prism poles (jacob staff) are checked and adjusted with a plumb bob and verified with a hand level. All other hand levels are checked with an adjusted prism pole.

2. Tripods are tightened and lubricated. Stability of legs, lock down clamps, and all moving parts are checked and adjusted.

3. Data collectors are run through a self-test routine before each survey trip. All survey data from previous trip is downloaded on to a disc, batteries replaced, and all configurations and parameters are checked and/or reset.

The designated surveyor on each survey is responsible to make sure that all of the above procedures for equipment maintenance have been followed. The surveyor will also document all checks and adjustments with the applicable maintenance forms.

GCES SURVEY PROTOCOL 1-15-91

TOPOGRAPHIC SURVEY

A. Total station set-up procedure will include the following:

1. Be sure the tripod is stable before mounting the instrument.

2. Instrument should be carefully leveled.

3. Set vertical index circle as per manual. (Do not use automatic indexing feature.)

4. The following information shall be hand written on hard copy as well as recorded in data collector:

a. Height of instrument in meters and feet.

b. Height of rod and extensions in meters and feet.

c. Vertical angles taken from vertical index verification.

d. Personnel and their duties, Job No.,Time and Date.

e. Temperature, Barometric pressure, and calculated PPM.

f. Horizontal angle, vertical angle, and slope distance of Backsight 1 and Backsight 2 (BS1, BS2).

5. The following information will also be recorded in data collector:

a. Coordinates, Elevation, and description of Total station Benchmark (BM) as per control survey data.

b. Azimuth direction or coordinates of BS1 or available BS as per control survey data.

6. BS1 and at least one other BS will be measured. Horizontal distance and elevation of both BS's must correlate with control survey data. Horizontal angle from BS1 to second BS must correlate with control survey data. If these constants do not check, repeat all the above set-up measurements and make sure correct BM and BS's are being used.

7. Check BS1 (re-zero) at least every 50 measurements, or as often as conditions may require.

8. When survey the is completed, measure both BS's to make sure all measurements have remained constant.

B. The following information and protocol is subject to modifications and improvements based on previous survey data. These changes will be updated at Surveyor-Crew Leader meetings

1. Acceptable error on BS elevation and distance measurements.

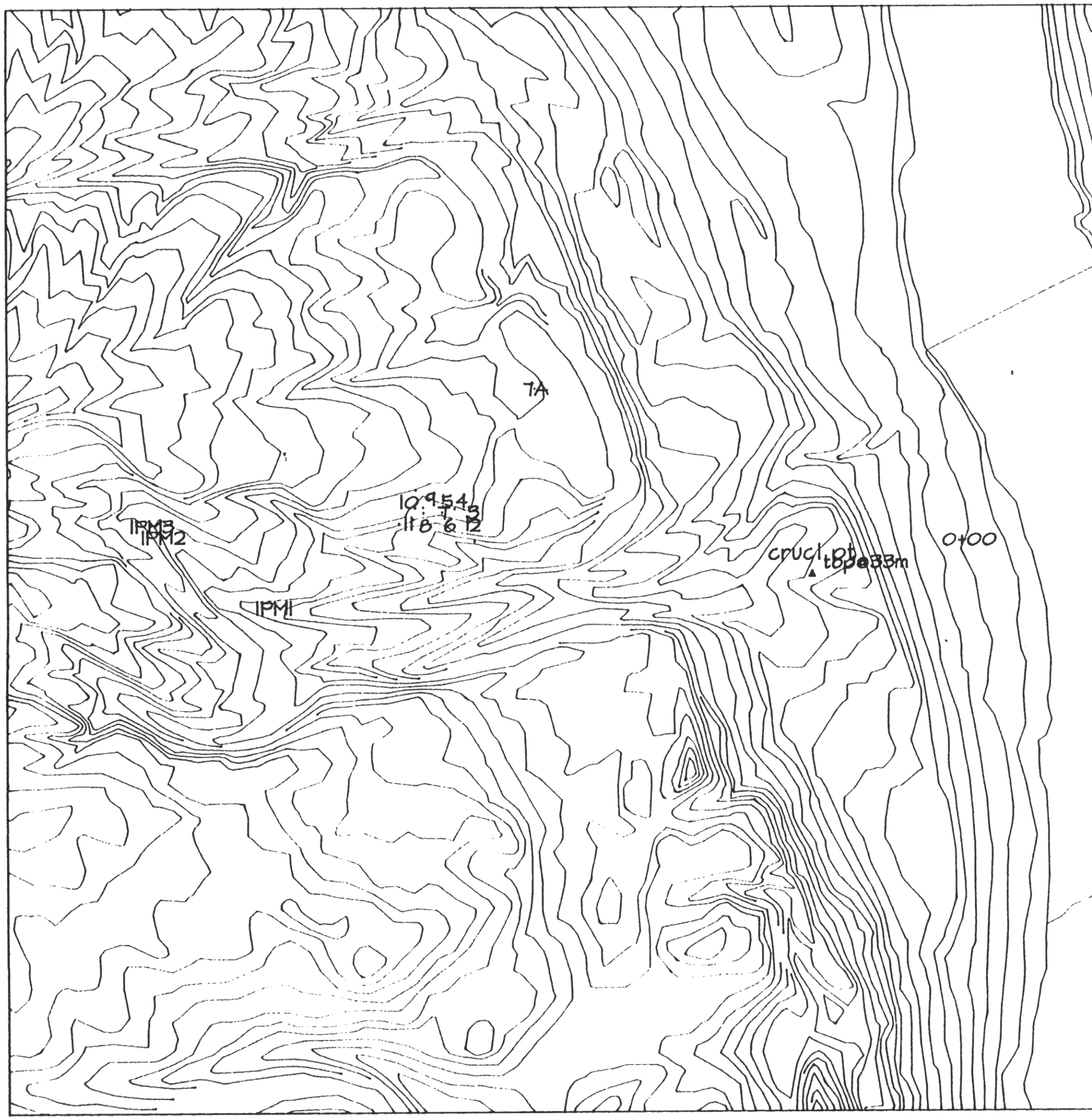
2. Acceptable angular error when re-zeroing BS1.

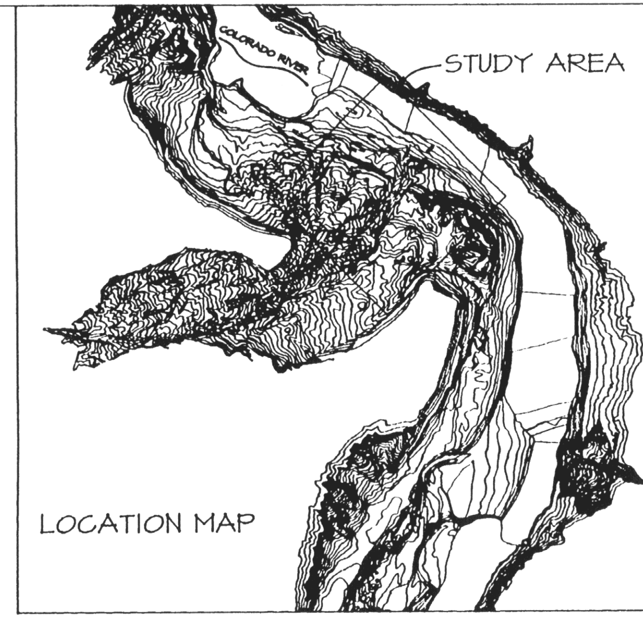
3. Rodman's procedure in selection of points to record effective topographic data.

4. Codes used in data collector to identify features located.

APPENDIX F

SOUTHERN PAIUTE VEGETATION MONITORING LOCATIONS: EXAMPLE OF A MAP PRODUCED BY THE GCES SURVEY DEPARTMENT





Nankoweap Creek Archeological and Vegetation locations. July 7, 1995

DATE	REVISION	NANKOWEAP MONITORING SITE		
7-17-95	INITIAL PLOT	GLEN CANYON ENVIRONMENTAL STUDIES SURVEY DEPARTMENT P.O. BOX 22454, FLAGSTAFF, AZ. 86001-2454 520/556-7459		
PROJECT ID		SHEET	PLOT FILE	DRAWN BY
scale= 1 : 1500		1 of 1	NANKO.PLT	rcb

APPENDIX G

SITE DESCRIPTIONS AND SPECIES LISTS FOR SITES NOT VISITED IN 1993

Site Descriptions and Species Lists for Sites Not Visited in 1993

Note: Plants listed in bold are Southern Paiute culturally significant plants, as identified in the 1993 ethnobotanical study (Stoffle, Halmo, Evans, and Austin 1994).

Vulcan's Anvil Beach -- Locus 1, Mile 178 R (11 July 1995)

The Vulcan's Anvil beach study site is on a small, steep beach on the right bank directly across from the anvil. This is the closest place on the shore to the anvil. Dense vegetation and large boulders line the shore, and steep, unstable uneven dunes form the lower part of the beach below the Old High Water Zone. A steep, loose talus of rocks, sand, and Bright Angel shale leads from the upper end of the beach to the cliff base. Saltcedar and desert broom dominate in the riparian zone, while catclaw acacia and creosote bush are most abundant on the steep slopes above the beach.

Species observed:

Acacia greggii	Catclaw acacia
Ambrosia dumosa	**White bursage**
Aristida purpurea	Purple three-awn
Baccharis sarothroides	Desert broom
Bebbia juncea	Chuckwalla's delight
Bothriochloa barbinodis	Cane bluestem
Brickellia longifolia	Long-leaf brickell-bush
Bromus rubens	Red brome
Cryptantha holoptera	Rough-stemmed cryptantha
Cynodon dactylon	Bermuda grass
Dicoria brandegei	Single-fruit dicoria
Encelia farinosa	**White brittlebush**
Ephedra nevadensis	**Nevada Indian-tea**
Equisetum laevigatum	**Smooth scouring rush**
Eriogonum inflatum	Desert trumpet
Eriogonum wrightii	Wright shrubby buckwheat
Gutierrezia microcephala	**Three-leaf snakeweed**
Haplopappus acradenius	Shrubby goldenweed
Haplopappus spinulosus	Spiny goldenweed
Larrea tridentata	**Creosotebush**
Lepidium montanum	Mountain peppergrass
Muhlenbergia porteri	Bush muhly
Phoradendron californica	Desert mistletoe
Solidago altissima	Tall goldenrod
Sporobolus cryptandrus	Sand dropseed
Sporobolus giganteus	Giant dropseed
Stanleya pinnata	**Prince's plume**

Stephanomeria exigua	**Wire lettuce**
Tamarix chinensis	**Saltcedar, tamarisk**
Thamnosma montana	**Turpentine broom**
Yucca whipplei	**Whipple yucca**

Prospect Canyon Smudging Site, Locus 3, Mile 179 L (13 July 95)

This site is along the upstream edge of the ancient debris fan at the mouth of Prospect Canyon. The large fan has been stable for many centuries and supports climax Mohave Desert vegetation. It is above the fluvial influences of the Colorado River and Prospect Creek, and was not affected by the mudflow event of March, 1995. Numerous boulders and cobbles are imbedded in the coarse soils of the debris fan. Dominant vegetation is creosotebush, with Navada Indian-tea and California barrel cactus abundant.

Species observed:

Acacia greggii	Catclaw acacia
Ambrosia dumosa	**White bursage**
Aristida purpurea	Purple three-awn
Bebbia juncea	Chuckwalla's delight
Bromus rubens	Red brome
Camissonia walkeri	
Cryptantha pterocarya	Wing-nut cryptantha
Cryptantha sp. (annual)	Cryptantha
Delphinium parishii	Desert larkspur
Dyssodia porophylloides	San Felipe dyssodia
Echinocereus triglochidiatus	**Claretcup cactus**
Ephedra nevadensis	**Nevada Indian-tea**
Eriogonum fasciculatum	California buckwheat
Eriogonum inflatum	Desert trumpet
Erioneuron pulchellum	Fluff grass
Ferocactus acanthodes	**California barrel cactus**
Galium stellatum	Desert bedstraw
Haplopappus spinulosus	Spiny goldenweed
Hilaria rigida	Big galleta grass
Larrea tridentata	**Creosotebush**
Lepidium lasiocarpum	Annual peppergrass
Lycium fremontii	**Fremont wolfberry**
Muhlenbergia porteri	Bush muhly
Opuntia erinacea	**Grizzly bear cactus**
Opuntia whipplei	Whipple cholla
Peucephyllum schottii	Pygmy cedar

Plantago insularis	Indian plantain
Porophyllum gracile	Poreleaf
Sphaeralcea grossulariaefolia	Globemallow
Vulpia octoflora	Six-weeks fescue

Rock Art Site Above Parashant -- Mile 198 R (13 July 1995)

This site has a well-developed river edge community with dense scouring rush, spiny aster, Bermuda grass, and patchy saltcedar. The steep bank above the river is heavily vegetated and could be considered a narrow marsh. Away from the river a steep, rocky and sandy slope leads up to a ledge of basalt ca. 15 m thick, with its bae about 60 m from the river. The lower slope has large desert broom in a line on the beach with dense mesquite and acacia above in the Old High Water Zone up to the base of the cliff. Intermediate sandy areas have dense arrowweed. The site is densely vegetated from the shoreline to the base of the cliff; mesquite is especially dense at the top of the slope.

Species Observed:

Acacia greggii	Catclaw acacia
Aristida purpurea	Purple three-awn
Aster spinosus	Spiny aster
Baccharis emoryi	Emory seepwillow
Baccharis sarothroides	Desert broom
Bromus rubens	Red brome
Clematis ligusticifolia	Western virgin's bower
Cynodon dactylon	Bermuda grass
Encelia farinosa	**White brittlebush**
Ephedra nevadensis	**Nevada Indian-tea**
Equisetum laevigatum	**Smooth scouring rush**
Erigeron lobatus	Lobeleaf fleabane
Eucnide urens	Rock-nettle
Ferocactus acanthodes	**California barrel cactus**
Gutierrezia microcephala	**Three-leaf snakeweed**
Haplopappus spinulosus	Spiny goldenweed
Lepidium lasiocarpum	Annual peppergrass
Lycium fremontii	**Fremont wolfberry**
Melilotus alba	White sweet clover
Mirabilis bigelovii	Wishbone bush
Opuntia basilaris	**Beavertail cactus**
Opuntia phaeacantha	**Engelmann prickly-pear**
Phoradendron californica	Desert mistletoe
Plantago insularis	Indian plantain
Porophyllum gracile	Poreleaf

Prosopis glandulosa* var. *torreyana	**Torrey mesquite**
Salix exigua	**Coyote willow**
Solidago altissima	Tall goldenrod
Sporobolus cryptandrus	Sand dropseed
Stanleya pinnata	**Prince's-plume**
Stephanomeria pauciflora	**Wire-lettuce**
Tamarix chinensis	**Tamarisk, saltcedar**
Tessaria sericea	**Arrowweed**
Vulpia octoflora	Six-weeks fescue