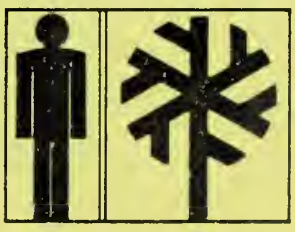
environmental assessment

NATURAL RESOURCES MANAGEMENT PLAN

LEHMAN CAVES



NATIONAL MONUMENT
NEVADA

NATIONAL PARK SERVICE / DEPARTMENT OF THE INTERIOR / REVISION OF FEBRUARY 1980

Proposed

NATURAL RESOURCES MANAGEMENT PLAN AND ENVIRONMENTAL ASSESSMENT

LEHMAN CAVES

NATIONAL MONUMENT

NEVADA

PREPARED BY
LEHMAN CAVES NATIONAL MONUMENT
NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR
REVISION OF FEBRUARY 1980

ABSTRACT

The Natural Resources Management Plan (NRMP) for Lehman Caves National Monument is a proposed action plan. This plan includes an environmental assessment prepared to document potential environmental impacts.

Proposed Actions

This NRMP revision of 1980 replaces the original document dated September 1974. The revision proposes actions in two categories: research and management. The purpose of these actions is to protect the cave formations and to maintain the monument's geologic and biotic communities. Research proposals include a continuing study of algae and mosses in the cave to determine ecologically safe control measures, a seismic and geologic inventory of the monument to determine the extent of the resource and to investigate potential problem areas, water resources studies, development of a Water Resources Management Plan, a biological inventory of the cave interior to define the biotic communities present in the cave, and an air quality assessment and monitoring. Management actions include algae and moss reduction and modifications of use patterns based on study results.

Impacts

Environmental impacts include beneficial and adverse effects. Studies on algae and mosses, geologic and biological inventories, and a seismic survey will contribute to sound management of the cave environment. Studies related to air quality and pollutant evaluations will provde guidelines for preserving the natural systems. Research design will avoid adverse effects on the cave. An inventory of ecosystems will aid in the understanding of biological parameters and will contribute to regional planning of the Wheeler Peak area. Algae and moss reduction will result in protected formative material and will allow visitors to observe a living cave under natural conditions. Human impact and carrying capacities will be studied in relation to preserving the existing cave system and will insure cave longevity, but may on occasion cause visitor inconvenience when capacity limits are reached. The quality of the visitor's experience will be enhanced, but the monument would be exercising restraints on the volume of public use.

Alternatives

The no action alternative has been considered. This alternative assumes no change in the existing monument management policies. The land within the monument would continue to be protected from any physical development that would destroy or disturb the natural ecosystem, but there would be no new research or management programs designed to cope with the problems inherent with use and visitation.

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DESCRIPTION OF THE PROPOSAL

Lehman Caves National Monument was established on January 24, 1922 by Presidential Proclamation under tha Antiquities Act of 1906. The proclamation sets forth to reserve the caves with as much land as may be necessary for its protection; monument lands comprise 640 acres or a perfectly square section of the Snake Range (Figure 2). Lehman Caves is managed according to Management Policies of the National Park System.

The resources measures included in this plan are based on management objectives first approved in September 1971. Resource management is intended to:

> Protect the cave formations and surface features in such manner as to preserve the natural ecology and maintain physical developments to a standard that will present the pleasing appearance of a well managed park area.

RESEARCH

Algae and mosses grow in close proximity to artificial lights in the cave. They grow on cave formations and, in some places, have become embedded in the rock. In other places, spores in the soil are spread by human foot traffic.

A 1968 report submitted by Dr. Nellie Stark of the Desert Research Institute stated, in part, that:

> The spread of algae and mosses from one light to the next is probably aided by maintenance men servicing the lights. Although photosynthetic plant life was not a part of the original unlighted caves, once light was added, plant life does become a part of the caves and adds considerably to the aesthetics and interest.

The study objective was primarily to determine air flow within the cave. Air data was needed before construction of the exit tunnel, in order to check the need for air locks in the doors of the tunnel.

Prior to 1971, algae and mosses were controlled in the vicinity of the lights by spraying a bleach compound such as clorox on the

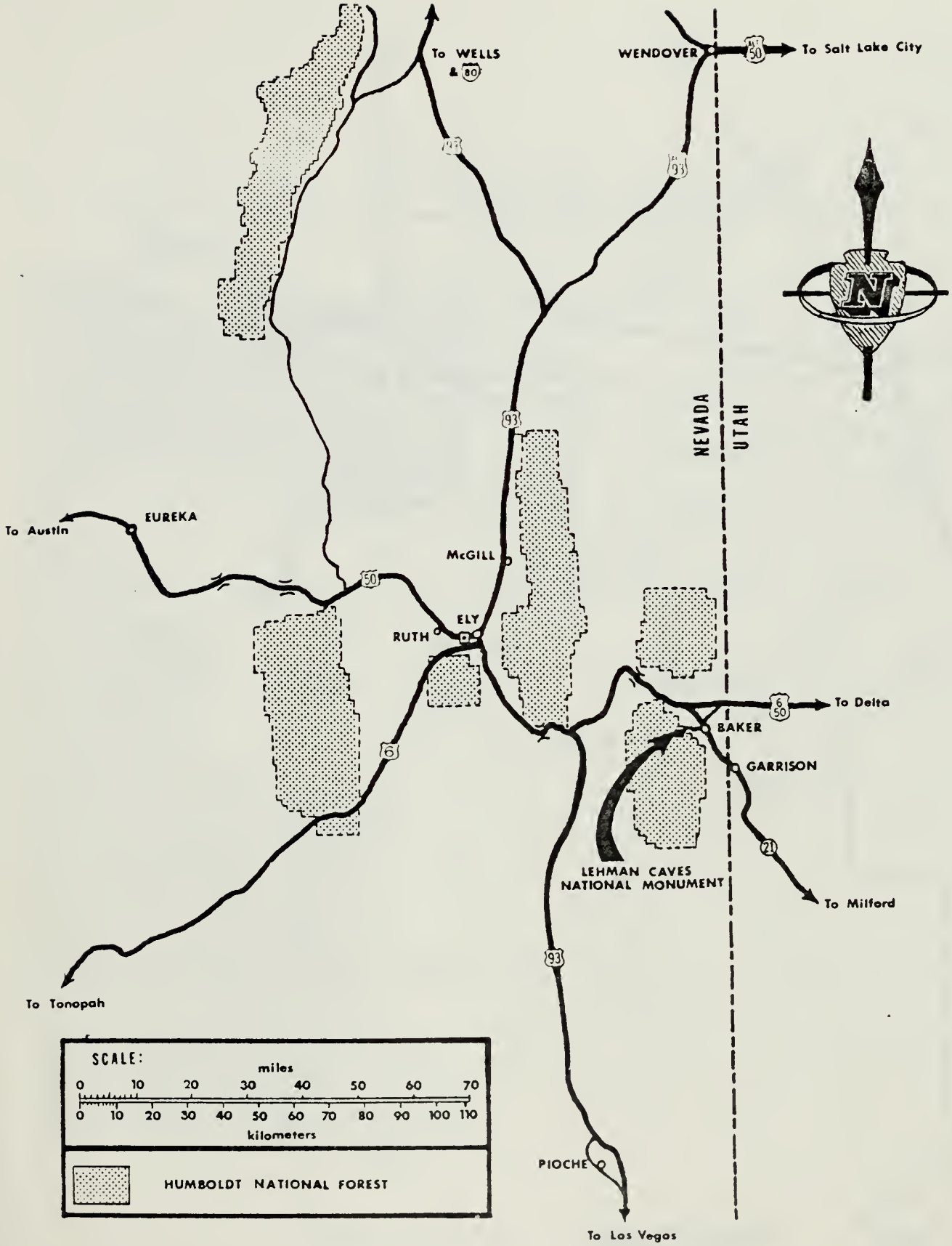


FIGURE 1. REGIONAL MAP

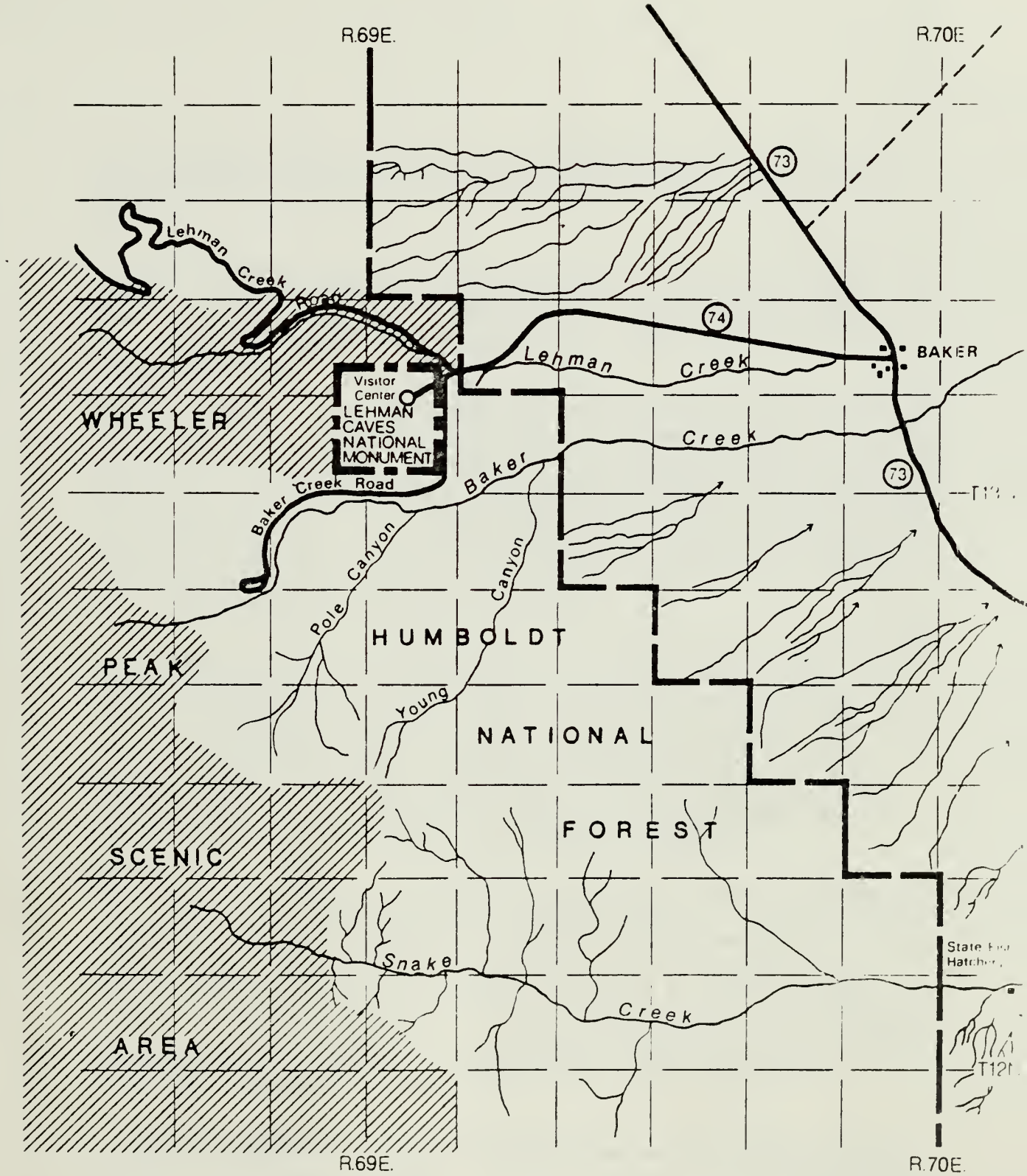


FIGURE 2. LOCAL MAP

affected area. This practice was discontinued for two reasons: it was not known what long-term effects the bleach would have on the formative cave material and an unpleasant odor lingered after treatment.

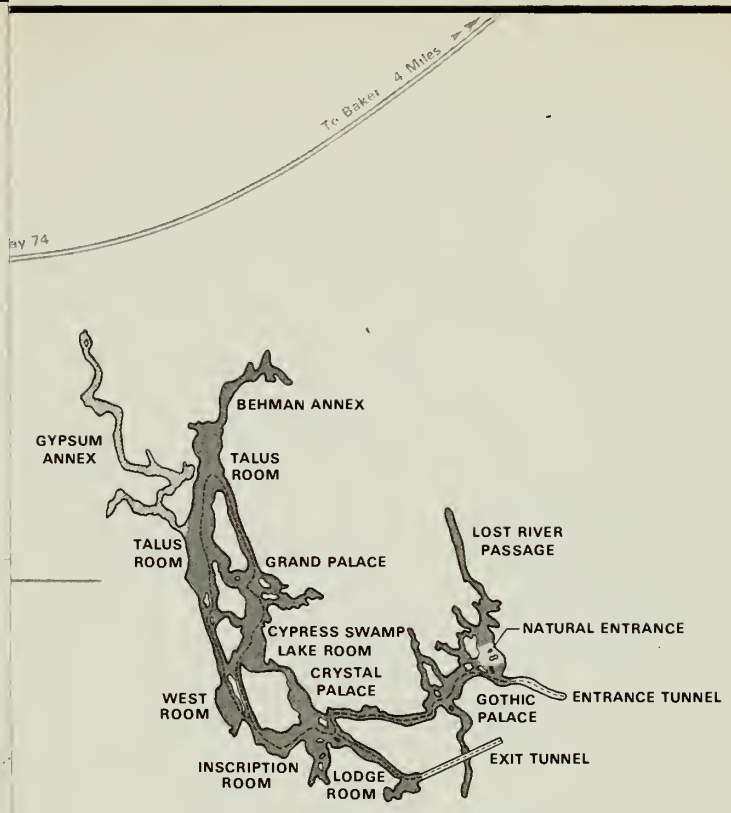
A study was begun in late 1974 by Dr. Lynn of University of Utah in a further attempt at defining the algae and moss species growing in the cave. Once the types were outlined, it was hoped that less than optimum growing conditions could be used to limit a majority of the exotic communities.

In the meantime, since the quantity of algae and moss was proportional to the quantity of light, bulbs of lesser wattage were used to replace lights in especially high growth areas. In addition, the rewiring of the cave in 1977 added several new lighting segments and provided the opportunity to turn off some lights that had previously been included in larger sections. The limiting effect of the light change has been substantial, but not so much as to eliminate the problem. Studies will be continued, and the amount of light will be recorded to aid in the understanding of the growth parameters.

Human impact on the cave environment is heaviest during the summer and is concentrated on holiday weekends like Easter, Memorial Day, the Fourth of July, and Labor Day. Lehman Caves is a prime spot for local recreation and special events. The Latter Day Saints Aaronic Priesthood Day on May 19th is a church sponsored father-son day. On this day or the nearest weekend to it, fathers and sons camp and sightsee together. Another day of heavy travel is when the Snake Valley reunion is held annually in September at the Forest Service Lehman Creek campground, three miles from the monument.

More than 1,100 visitors have toured the caves on individual peak days. Cave tours were given every twenty minutes, or as guides were available, and were limited to not more than fifty persons at a time. At such times, it is easily observed that the cave experience is diminished and that the environment is subject to excessive human impact. Presently, tours are limited to 30 people and are conducted a minimum of 30 minutes apart (as per recommendation of the carrying capacity study.) However, as we develop a good understanding of the total cave ecosystem, further modifications may be required.

Groundwater resources are not completely known and an inventory is needed in order to find available potable water for pumping, in the event of a prolonged drought. The soil mantle is thin and permeable. Surface water such as rain or melting snow is absorbed rapidly and depths to the water table are unknown.



LEHMAN CAVES DETAIL

Environmental Protection Sub Zone

Outstanding Natural Feature Sub Zone

Historic Zone

Developed Trail System

0 220 440

SCALE 1" = 220'

LAND CLASSIFICATION
LEHMAN CAVES
NATIONAL MONUMENT

LEGEND

	SUBZONE	SYMBOL
URAL	Natural Environment	
	Outstanding Natural Feature	
ORIC		
ELOPMENT		

400 200 0 400 800

SCALE IN FEET

NORTH

148	80,006
FEB. 77	WRO-PP

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Enlarged from U.S.G.S. Map (Garrison, Nev.-Utah, 1951)

To Baker Creek

precipitation - 1976-1978 are metered values)

FIGURE 4. WATER FLOW & USAGE

LEHMAN CAVES DETAIL

Environmental Protection Sub Zone
Outstanding Natural Feature Sub Zone
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0 220 440
SCALE 1" = 220

LAND CLASSIFICATION
LEHMAN CAVES
NATIONAL MONUMENT

LEGEND

ZONE	SUBZONE	SYMBOL
NATURAL	Natural Environment	
	Outstanding Natural Feature	
HISTORIC		
DEVELOPMENT		

400 200 0 400 800
SCALE IN FEET

NORTH

148 | 80,006
FEB 77 | WRO-PP

U S Department of the Interior National Park Service

FIGURE 4. WATER FLOW & USAGE

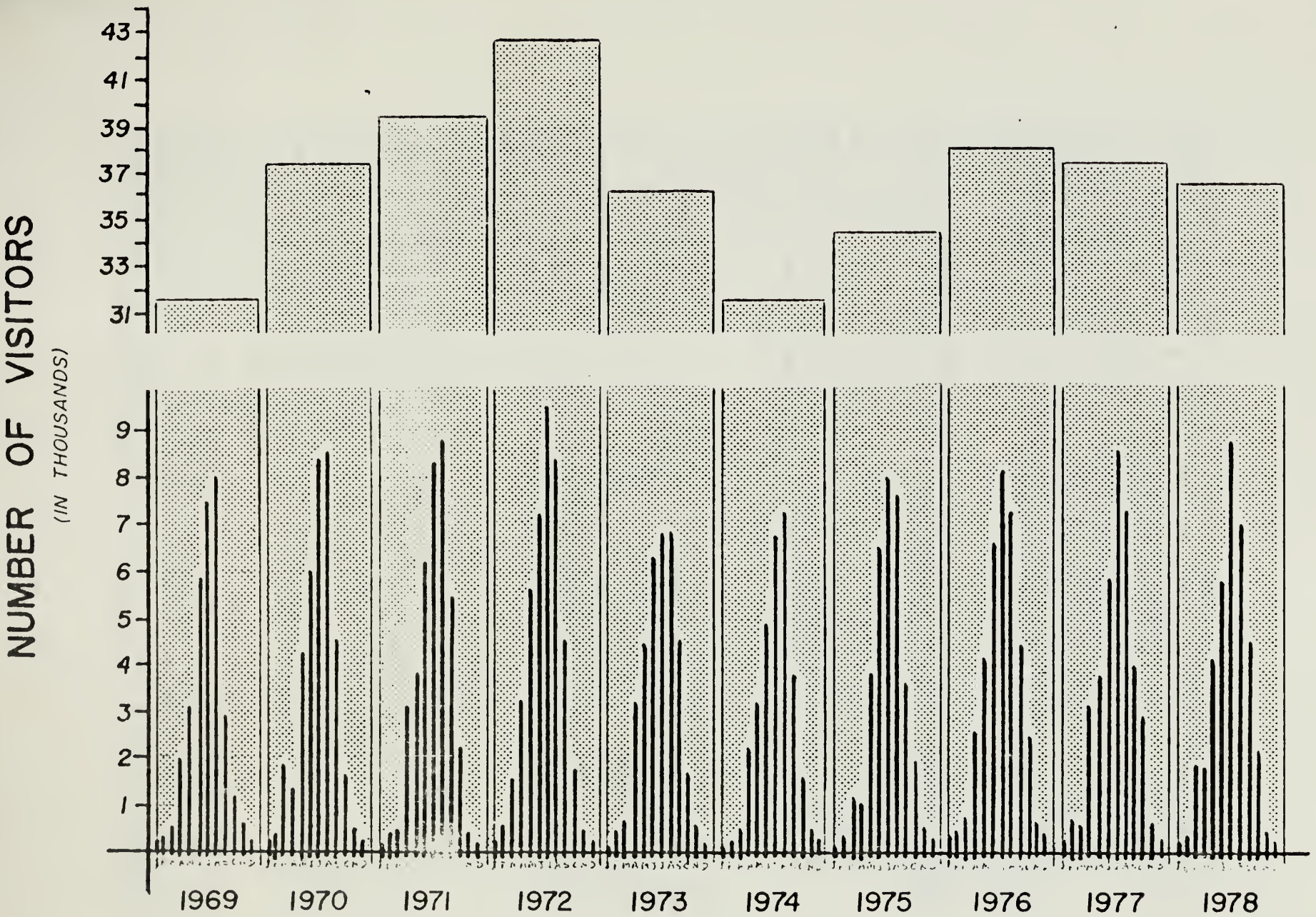

FIGURE 5. VISITOR USE PATTERNS

The monument's water supply is from a series of springs on adjacent National Forest land. Sufficient water was obtained from these springs until August 1972 when the upper spring began to fail. Normal input is 42 to 50 gallons per minute into a 50,000-gallon storage tank. During August, flow dropped to 17 gpm which is insufficient for monument needs (Figure 4). Lawn sprinkling was curtailed for the remainder of the year and the picnic area was closed in order to conserve water. In this arid climate, available water is used to maintain public health and safety standards and to maintain grounds for the visiting public.

Soils on monument lands support native pinyon pine and Utah juniper; an inventory of major soils is proposed to provide an informed basis for vegetation management. The soil mantle is thin, overlying rocks and glacial moraine boulders of unknown depths. Approximately two-thirds of the monument rests on an alluvial plain, which dips from west to east 500 feet per mile. The remaining one-third is composed of low limestone and granite ridges rising less than 500 feet above their surroundings, but which culminate outside the monument in the summit area of Wheeler Peak at an elevation of 13,000 feet.

Biologic communities at Lehman Caves have not been adequately surveyed. A flora checklist is completed but information on community structure and succession patterns is needed. Future resource management actions require an informed basis: the role of fire and the extent of forest disease or infestation have not been investigated. At present, park management relies on Forest Service data applying to larger surrounding areas of Humboldt National Forest. A detailed survey of local plant ecology on the fringes of the national forest would augment resources management to standard.

Biologic inventory of the cave interior has long been overlooked and a concentrated effort has been directed toward "exotic" species. A thorough understanding of existing ecosystems (both botanic and zoologic) must preceed any modifications brought about through human intervention. The introduction of trails, lighting and similiar "unnatural" forces has affected the biotic communities, but we really have little idea of what might have preceded human use of the cave. The study should encompass micro- as well as macro-organisms and should include former residents (pack rats, etc.), so that management can be directed from an informed perspective.

Geologic inventory of the monument has been approached, but not effectively accomplished. Due to the nature of the substrate evident on monument grounds, large sections of limestone and marble have not been investigated. By accurate fault mapping and shot-charge transecting, the existance of subterranean cavities and resulting fault patterns

can be determined. Since surface modifications have a marked effect on caves, every effort should be made to determine the existence of presently unknown caves to prevent unknowing destruction of a possible additional resource.

For water resources management over the long-term a study will be planned to assure compliance with Federal laws and maintenance of water quality standards.

A seismic survey of the existing cave also will be completed to allow management to be informed of possible weak spots in the presently known cave. From a safety point of view, much of the cave ceiling and walls present a potentially hazardous unknown. If additional cavities exist immediately above or below the present rooms, a potential collapse situation could occur and management needs the information to make necessary modifications to protect the health and safety of visitors and monument personnel.

Air quality and pollutant levels will be monitored and evaluated. Trends will be documented. Now air quality in the monument is excellent. Monitoring will complement any State TSP and EPA fine particulate monitoring underway or scheduled in the area. Without accurate measures of air quality, we will be unable to assess the changes that might take place in subsequent years, and thus management decisions may not be as sound as desirable.

MANAGEMENT ACTIONS

Algae and mosses. Techniques developed in the aforementioned research proposal will be applied to reduction management of algae and moss growth in the caves. Control will be limited to routine maintenance following initial reduction. Whichever technique is employed, formative cave material will be protected and homeostatic conditions will remain uninterrupted.

Visitor use impact. The continued monitoring of human impact on the cave environment may require modification of the carrying capacity. At the outset, capacity will be based on available interpretive personnel and the physical limits of the cave. Since 30 persons every 30 minutes has proven satisfactory, a lesser use level will be employed only if required. Adjustments will be made until visitor use is commensurate with the cave capacity.

Fire Management. At this time, all wildfires in the monument are suppressed. Lehman Caves National Monument has a written cooperative agreement with the Ely District, Humboldt National Forest, wherein each will suppress wildfires on their land in the vicinity of the monument. In addition, both agencies will assist each other in suppressing fires that threaten to burn onto the other's land.

Fire frequency is low. People start an average of one fire per year, and this is usually an accidental ignition occurring in the picnic area. While lightning is common in this mountainous region, only about one fire in three years can be attributed to lightning in the monument.

While it is recognized that fire is a natural factor which influences the character and composition of the vegetation, the monument will continue to have a wildfire suppression policy for the immediate future. The relative small size of the monument, limited fire staff, fire suppression policy and fuel situations on adjacent Forest Service land preclude a natural or prescribed fire program at this time. However, it is probable that a fire program will become part of the overall management plan with the advent of fire-qualified staff on the monument and revision of the suppression policy on adjacent Forest Service lands.

RELATIONSHIP OF PROPOSAL TO OTHER PLANS AND PROJECTS

Lehman Caves National Monument and Humboldt National Forest established a cooperative fire agreement, effective August 1973. Fire management contained therein deals with boundary fires threatening either adjacent landholder. Fire protection is defined as the prevention, detection, presuppression, and suppression of wildfires.

Planned development at the monument includes installation of another 50,000-gallon storage tank to double the present water supply in the event of a major fire. Engineers estimate that the present 50,000-gallon water supply would last only 1 1/2 hours if intensive fire fighting is required.

Although Lehman Caves is managed as a natural areas, natural fires are not allowed to run their course because 1) the monument constitutes a limited 640 acres surrounded by national forest whose policy is to suppress all fires, 2) existing facilities include a large visitor center occupied by Park Service and Forest Service personnel and a concession, as well as nearby structures nominated to the National Register, and 3) proposed development includes a six-unit apartment building in addition to existing residence buildings.

Another cooperative agreement between Lehman Caves and Humboldt National Forest concerns sewage treatment facilities. Conversion of the monument's septic tank and leachfield system to a sewage lagoon system has been accomplished. Construction of a second lagoon, and sewer line extensions, and a trailer dumping station will be financed by both agencies. Water monitoring stations have been established on Lehman Creek by the Forest Service, and the residents below Rowland Spring are sending samples to the State Health Department laboratory for analysis. It is expected that the system will eliminate potential leakage and percolation of polluted water.

DESCRIPTION OF THE ENVIRONMENT

Lehman Caves National Monument is located five miles west of Baker, Nevada in White Pine County at the terminus of Nevada State Highway 74 (Figure 2).

The Snake Mountain Range on the eastern edge of Nevada is topped by 13,063-foot Wheeler Peak, one of the highest mountains in the Great Basin. The one-square mile monument is on the eastern flats of this baldheaded monarch. It is in the pinyon pine and juniper belt at an average elevation of 7,000 feet. East of Lehman Caves lie the Snake Valley flats.

CLIMATE

The climate of Lehman Caves is characterized by its location in the high desert country of eastern Nevada. The mean annual rainfall of 13.2 inches is evenly distributed throughout the year. Precipitation comes from Pacific storm fronts during the fall, winter, and spring and from thunderstorms during the summer. About four out of thirty thunderstorm days in the year produce hail, generally small and causing no serious damage. Relatively mild temperatures prevail throughout the year. Only a few summer days exceed 90 degrees Fahrenheit and a few winter days drop below zero. See climatological summary on the following page.

There are only a few farms and widely scattered ranches in the Snake Valley. An average growing season of 123 days at the caves combined with the summer rainfall keep the desert flowers blooming in profusion in the high country. The growing season in the Snake Valley is somewhat shorter due to cold air drainage down the mountains to the valley floor.

Periodic drought years have a marked effect on the springs and creeks in the Snake Range. During the calendar years of 1976 and 1977, Lehman Caves experienced a deficit (from normal) in precipitation of 4.87 and 3.43 inches respectively. A comparison in previous years has shown a correlation between precipitation and spring flow. However, during the drought period of 1976-1977 an adequate flow was obtained at the water source spring to allow the Monument to function normally. In 1978, the precipitation returned to normal and early 1979 has been extremely wet.

CLIMATOLOGICAL SUMMARY

Latitude 39° 00' N
Longitude 114° 13' W
Altitude 6825 Feet

Station: Lehman Caves N. M.

Means and Extremes for Period 1941- 1978

Month	Temperature (°F)							Mean degree days **	Precipitation Totals (Inches)								Mean # of Days					Month
	Means			Extremes								Snow, Ice Pellets					Precipitation of .10 inch or more	Temperature				
																		Max		Min		
	Daily maximum	Daily minimum	Monthly	Record Highest	Year (19--)	Record Lowest	Year (19--)		Mean	Greatest Daily	Year	Mean	Maximum Monthly	Year	Greatest Daily	Year		90° and above	32° and below	32° and above	0° and below	
(a)	30+	30+	30+	30+		30+		30+	30+	30+		30+	30+		30+		30	30	30	30	30	
JAN	41.0	18.3	29.7	67	53	-20	63	1097	1.04	2.21	1954	11.7	34.0	1955	19.0	1954	3	0	6	30	2	JAN
FEB	43.7	20.8	32.3	68	47	-12	51	921	1.07	1.70	1945	14.2	44.5	1945	18.0	1969	3	0	3	25	1	FEB
MAR	47.8	22.4	35.1	70	66+	0	48+	927	1.35	1.50	1963	19.4	51.4	1952	15.0	1952+	4	0	2	26	0	MAR
APR	50.6	30.4	40.5	78	49	10	50	735	1.28	1.62	1964	8.7	35.0	1964	25.0	1964	3	0	0	18	0	APR
MAY	66.4	38.3	52.4	84	69+	6	50	396	1.14	1.55	1957	2.7	26.0	1950	20.0	1964	3	0	0	7	0	MAY
JUN	76.0	46.5	61.3	97	54	14	50	164	.97	1.51	1941	0.5	8.0	1955	8.0	1955	2	1	0	3	0	JUN
JUL	85.9	56.5	71.2	100	58	32	50	0	.79	.85	1968	0	T	1950	T	1950	3	6	0	0	0	JUL
AUG	83.3	55.1	69.2	97	40	32	64	0	1.04	.82	1964	0	0	--	0	--	4	3	0	0	0	AUG
SEP	75.4	46.2	60.8	93	50	10	50	163	.76	2.35	1966	0.2	4.0	1941	4.0	1941	2	1	0	2	0	SEP
OCT	62.3	35.7	49.0	81	50	3	49	496	1.49	1.08	1961	4.3	41.8	1961	15.0	1961	3	0	0	10	0	OCT
NOV	49.6	24.8	37.2	78	41	-2	50	834	1.15	1.52	1960	12.0	55.0	1946	18.0	1957	2	0	2	23	0	NOV
DEC	42.7	19.1	30.9	78	43	-13	72	1057	1.14	1.58	1966	12.4	46.0	1951	24.0	1947	3	0	5	29	1	DEC
YEAR	60.7 @	35.2 @	48.0 @	100	58	-20	63	6790	12.93 @	2.35	1966	83.6 @	55.0	1946	25.0	1964	35	11	17	173	4	YEAR

(a) Average length of record
T Trace (an amount too small to measure)
@ **Average figures are based on data from reports for 1951-1973**

\+ Also on earlier dates
** Base 65° F

VEGETATION

The vegetation at Lehman Caves is primarily pinyon-juniper forest. The common junipers are Utah juniper (Juniperus utahensis), one-seed juniper (J. monosperma), and common juniper (J. communis), and single-leaf pinyon pine (Pinus monophylla) is the most common pine. This forest type is a stable community that occurs in a transition zone between the sagebrush community to the east and the ponderosa pine, englemann spruce, and douglas fir at higher elevations to the west on Wheeler Peak.

The pinyon-juniper type is found in the southern Rockies, Sierra Nevada, and in the ranges of the Great Basin. It is an open, dry woodland dominated by distinctive species which reach a height of twenty to forty feet. The understory is comprised of shrubs and bunchgrasses, which become dominant after natural or man-caused disturbances. At Lehman Caves, the 640 acres of forest have become slightly more dense over the period 1950-1971, as judged from photographs in Halladay and Peacock (1972). The increase in forest at the expense of the sagebrush openings is thought to be due to efficient fire suppression on the monument and on surrounding national forest lands, as well as long-term recovery from cattle grazing.

There is no complete flora list for Lehman Caves. A partial list of plants in the Wheeler Peak Scenic Area lists 339 species, representative of wider diversity than what exists on monument lands. Some of the more common shrubs on the monument are mountain mahogany (Cercocarpus ledifolius), big sagebrush (Artemisia tridentata typica), and rabbit-brush (Chrysothamnus nauseosus). The mountain mahogany is quite large and tree-like, and several of the larger known specimens are found on Forest Service lands adjacent to the monument. Common herbaceous species include sulphur flower (Eriogonum flavum), western wallflower (Erysimum capitatum), cliffrose (Cowania Mexicana), dark blue lupine (Lupinus argophyllus), common dandelion (Taraxacum officinale) and common sunflower (Helianthus annus).

WILDLIFE

Mule deer (Odocoileus hemionus) are common. It is not unusual to observe from fifteen to twenty deer from the visitor center during fall and early winter. Coyote (Canis latrans) are frequently seen or heard; bobcats (Lynx rufus) are rarely seen; and mountain lions (Felis concolor) are occasionally seen. Blacktailed jackrabbits (Lepus

californicus) are abundant, and as many as nine have been observed in one grouping. Few bats are observed, and there is little evidence that they ever occupied the cave for extended periods of time. Rodents are abundant, such as ground squirrels (Citellus townsendii), chipmunks (Eutamias dorsalis), and mice (several species).

The surrounding Humboldt National Forest is open to hunting during the fall. Deer move into the monument for protection and it is known that several older bucks have used this sanctuary for several seasons. A statewide cooperative agreement between the Nevada Fish and Game Department and the National Park Service insures that closures such as Lehman Caves are enforced.

Birds native to the area and commonly observed are Brewer's blackbird (Euphagus cyancephalus), Oregon junco (Junco oreganus), broad-tailed hummingbird (Selasphorus platycercus), red-shafted flicker (Colaptes cofer), scrub jay (Aphelocoma coerulescens), Clark's nutcracker (Nucifrage columbiana), mountain chickadee (Parus gambeli), and robin (Turdus migratorius). Other less frequent sightings include the golden eagle (Aquila chrysaetos), red-tailed hawk (Buteo jamaicensis), and the great horned owl (Bubo virginianus).

The Great Basin rattlesnake (Crotalus lotusos) is present and every summer from four to ten sightings are reported in the vicinity of headquarters. Lizards (species unknown) are abundant.

There are no known rare or endangered species in the monument.

GEOLOGY

The monument is within the physiographic Basin and Range Province, characterized by wide, flat-floored valleys bounded by north - and south - trending mountain ranges. The valley floors are desert with dry lake beds in many of them, resulting from interior drainage and high evaporation rates.

Approximately 600 million years ago during the Cambrian period, a warm and shallow sea rested inland, laying loose sediment to be consolidated into rock. Under pressure, underlying calcium carbonate became limestone, sands became sandstone, and silts became shales.

Prospect Mountain quartzite, exposed on Wheeler Peak, was originally beach sand which accumulated at the margin of the sea to depths of thousands of feet. The younger Pioche shale, which rests on the quartzite and is found lower on the mountain, was once dark gray mud and silt which settled out of the deepening water.

Pole Canyon limestone containing Lehman Caves was probably laid down as a white mud of calcium carbonate extracted from the sea water by microscopic organisms.

Near the end of the Cretaceous period, about 70 million years ago, compressional forces in the earth caused layers of rock and sediment to buckle and tilt. It is this tilt steeply to the east that brought the lowest quartzite formations to form the top of Wheeler Peak.

More recently, a mass of molten rock forced its way upward through the sedimentary layers and spread out laterally along receptive beds. (In the monument area, molten granite spread through the slate bed and entirely assimilated it). Heat and pressure contributed to the recrystallization of sedimentary rocks; magma cooled and solidified into igneous rock. Henceforth, magma yielded granodiorite; limestone became marble, sandstone became quartzite, and shales became slate.

Within the past few million years, glaciers have carved deeply into the Snake Range, leaving great marks in their passage. Even today, a permanent body of ice remains in a cirque in the shadow of Wheeler Peak.

Lehman Caves was formed by seeping water rendered slightly acidic by the activity of soil microorangisms. Limestone and marble are especially soluble in acidic solution; most caves occur in these rock types.

Two factors, the irregular network of passages and the remarkably flat ceiling of most of the cave system, indicate that the cave was dissolved by slowly moving water. The water table, or upper surface of the water, lay at the ceiling of the cave. Water below this saturated zone moves at a rate of a few tens of feet a year--fast enough to carry away the dissolved marble but too slow to be considered an underground river. If the cave had been carved by an underground river, it would now possess a downward gradient more like a surface stream and would lack the irregular network of passages.

Formation of the caves may be viewed as the gradual solution of marble over a period of tens of thousands of years. The north-trending passages follow certain soluble beds of marble, and the west-trending passages lie along fractures or joints.

Evidence at Lehman Caves permits a fairly close estimate of age. Poorly cemented gravel of late Tertiary or Quarternary age, eight miles southeast of the monument and along the highway that leads through the mountain range north of the monument, is tilted about twenty degrees to the west. The tilting of these gravel beds suggests that the entire Snake Range was tilted to the west since deposition

of the gravel. The flat ceiling of the cave which reflects a former horizontal water surface is still horizontal; hence the cave must have formed since the tilting of the range, otherwise the flat ceiling of the cave would also be tilted. This evidence indicates that the cave is geologically young, probably formed within the last one to five million years.

Upon entering, the cave air is damp, ranging from 95 to 100 percent relative humidity with a constant temperature of 52°F. The first room encountered is called the Gothic Palace, characterized by blue-gray marble bedrock and formations hanging from waterholding cracks. Next is the Lodge Room, where most of the formations have been knocked out to accommodate public meetings held in the past as promotional stunts. The Inscription Room contains names of early visitors who used torches to smoke their names on the ceiling. The Grand Palace is laden with formations which render names like Angel's Wing, Vegetable Garden, Rock Hound, and the Pearly Gates. Largest of all is the Talus Room, housing jagged blocks of rubble which fell from the ceiling when the earth's crust suddenly shifted along a fault some 10,000 to 30,000 years ago.

Lehman Caves contains living limestone formations - stalactites, stalagmites, platelike shields, cave coral, rimstone dykes, curling helictites, flowstone, draperies, and aragonite - which are naturally fragile. A uniformly cool temperature and slow percolation of water supports a limited margin of life, typically insects and microorganisms. For these reasons, people who come to see the caves should be made mindful of its early origins and homeostatic conditions. Litter and waste left behind take overly long to decompose and the smallest souvenir may be five million years old. As it is, human appurtenances in the caves amount to approximately 350 lights, cemented walkways, emplaced rocks, and wood stairs.

HYDROLOGY

Lehman Caves is located between two eastward flowing perennial streams on the eastern flank of Wheeler Peak. The streams drain surrounding Forest Service lands. From 1955 through 1974 the U.S. Geological Survey has maintained gauging stations in both of the streams: Lehman Creek, just north of the monument, and Baker Creek, to the south of the monument. The latter station is presently operated as a crest-stage gauge.

Cave Spring, which was once a tributary to Lehman Creek, is now diverted about one-half mile northwest of the monument boundary to provide a sole water supply.

The extent of groundwater in the monument is not presently known. The caves are a series of solution channels in limestone underlain by a granitic intrusion and a thick quartzite unit. Some water exists in the caves, but it is thought to be the result of precipitation seeping into the caves rather than a water table surface. There are no known wells in the immediate vicinity of the monument. Existing groundwater in the monument area, if any, would be probably due to recharge of aquifer system from Wheeler Peak, flowing west to east.

HISTORY AND ARCHEOLOGY

Among the early miners reaching eastern Nevada, Absalom S. Lehman came to prospect and ended up farming. He built a house from an abundance of stone on the land and raised fruit trees. Lehman Orchard and Aqueduct, nominated to the National Register of Historic Places, is below the visitor center and consists of seven apricot trees, two pear trees and a peach tree. Presumably over eighty years old, the trees still bear fruit. New, young trees were planted in 1976 through 1978 on the sites where original trees had died. While they are presently only saplings, they should begin to bear fruit in the coming years and return the orchard to its historical character. The aqueduct runs from the monument boundary for about one mile, encircling the orchard flat. Originally, the aqueduct was about two miles long and ran from a creek to the orchard; it was a shallow open ditch controlled by a board gate.

Another nominated site is Rhodes Cabin, built in 1928 and named after Clarence T. Rhodes, an early caretaker of the caves. The one-room log cabin was designed to house tourists and, during the 1930's, served as a residence for park employees.

Lehman Orchard and Aqueduct and Rhodes Cabin were nominated to the National Register of Historic Places on the basis of local significance. These nominations resulted from a historical survey in December 1971, by F. Ross Holland, Jr. Both sites are recommended for preservation, in accordance with Executive Order 11593, Protection and Enhancement of the Cultural Environment, May 13, 1971.

The monument and surrounding area is not completely studied archeologically. An intensive above-ground survey was completed in 1977. Some artifacts were found, but no significant archeological sites were unearthed. The excavations inside the cave have been inconclusive. In 1937, part of a natural accumulation of silt and gravel near the mouth of the cave was removed to enlarge the opening. The workmen recovered skeletal material from the fill. In 1938, as part of the entry project, some of the fill was excavated. The cultural materials were thought to be recent, but due to a lack of artifacts were not accurately dated.

In 1963 work was resumed by contract with the Nevada State Museum. The lower and upper entrance rooms were tested to bedrock. A total of

nineteen test pits totaling thirty percent of the surface area were excavated. An early water deposit contained animal and human bones. A later wind deposit contained eighteen fire hearths, ten artifacts, and over sixty fragments of human bone. The skeletal material represents perhaps twenty-one individuals thirty years of age at death or older. The lack of body skeletal material was evidence for the assumption that the burials were secondary. None of the artifacts were diagnostic so they are not dated. It may have been used as a secondary burial cave, but the samples are too small for adequate interpretation.

The dig area and the Panama Canal are being considered for recommendation to the National Register.

VISITOR USE

Summer travel to the monument comprises 85 percent of the annual visitation (Figure 5). Summer months average 200 to 300 visitors a day, beginning at Easter and continuing through Labor Day. Approximately 30 percent of the visitors who register come from California; another 30 percent from Utah; 15 percent from Nevada; and 25 percent from other states and foreign countries. Winter visitors are primarily from Utah (40 percent) and Nevada (30 percent). It has been observed that summer visitors include school age children and that winter visitors include retirement age couples.

SURROUNDING LAND USE

The monument is surrounded by the Snake Division, Ely District of Humboldt National Forest. National Forest land to the west has been classified as Wheeler Peak Scenic Area (Figure 2). Four campgrounds serve the area within a 12-mile radius of the monument. The National Park Service and the Forest Service maintain offices and information services at monument headquarters.

Mistletoe is prevalent throughout the area. Park Service and Forest Service personnel surveyed the area in 1971 and recommended no controls because entire, affected trees would have to be removed to achieve desired results. The Forest Service does not plan any mistletoe control in the foreseeable future.

The narrow strip of land to the east is unused except for an access road to Baker Creek. Land to the south supports outdoor recreation uses such as camping, fishing, and hunting. In addition, a few permittees utilize limited grazing rights.

Privately owned land further east supports low density cattle and sheep grazing, and where sufficient water is available, a few homesites and cultivation of hay, cattle feed, gardens, and orchards.

The small village of Baker (population 50) encompasses a store, motel, trailer park, restaurant, service station, elementary school (1-8 grades), and two saloons. Residents are dependent on two large ranches for employment and businesses cater to a modest tourist trade.

Lehman Caves, Humboldt National Forest, and nearby landowners are dependent for water from winter snowfall and precipitation at higher elevations. Water is used for domestic purposes, wildlife and domestic stock, and irrigation of farms in Snake Valley. A closed system supplying groundwater historically has provided water of excellent quality at Lehman Caves.

Local economy will continue at a low growth rate unless subdivision of ranchland takes place. In 1972, the opportunity arose to subdivide the old Rowland Ranch into 900 half-acre homesites. The proposal met considerable opposition from several adjacent homeowners. Such development would dramatically increase the growth rate of Snake Valley. It would result in additional tourist trade and businesses--and, lying two miles east of Lehman Caves, it would affect visitor use patterns at the monument.

AIR QUALITY

The air quality at Lehman Caves has historically been excellent. Aside from infrequent dust storms in the Snake Valley and the heavy use of dirt roads during the first few days of hunting season each year, the air is low in suspended particulates. The pollutant levels measured thus far have all been well below levels established as maximum State and Federal standards.

ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

RESEARCH

Studies on algae and mosses and interior biota will both contribute to the management of long-lived natural cave environment. Separate test plots for known control agents of algae, such as chemical treatment and light manipulation, will indicate an optimal method for maintaining a natural cave environment. The primary effects of test plot study include the small, permanent scars left by markers, and the unknown substrate reactions to different chemical applications. Test plot readings over a year or more have indicated the effects of different control methods which would not be otherwise observable. If control measures are recommended, a reduction in accidental or purposeful destruction may result. The study is designed to avoid adverse effects on the formative material and prime features of the cave.

An inventory of groundwater resources and a Water Resources Management Plan will provide a known source of water in the event of a prolonged drought. Since surface water is limited to two streams just north and south of the monument, a known source of groundwater would be of far-reaching benefit in an arid region in the event of a shortage. An inventory would provide further information on the Wheeler Peak aquifer system and may indicate limits of its use requiring regional planning. If this should be the case, then an inventory would provide the basis for management actions of long-range benefit.

Inventories of soils and biotic communities, and air quality on the monument will contribute to informed management.

MANAGEMENT ACTIONS

Reduction management of algae and mosses in the cave will result in protected formative material. The visitor will be able to observe a living cave under "natural" conditions. The effects of algae and moss removal on cave invertebrates is not known. Potential effects of "sterilizing" certain cave areas include removal of living and decaying food sources, wiping out percolated water-carrying organic matter, and disrupting habitat and breeding patterns.

Enforcement of the carrying capacity will minimize visitor use impact and improve the quality of the cave experience. Incidents of littering and breaking off cave formations will probably decline. Visitors will benefit from an interpretive tour of a naturally maintained cave, but overflow visitors are subject to the inconvenience of waiting and to increased restraints on cave use.

MITIGATING MEASURES INCLUDED IN THE PROPOSED ACTION

Proposed research on algae and mosses, groundwater resources, soils, biota, geology, and air quality along with development of a Water Resources Management Plan will provide an informed basis for future management actions.

Proposed management actions - algae and moss reduction and limited visitor use - will not take place until related studies make available tested methods which are optimal for the resource.

Test plots highly visible to cave visitors will be interpreted. In this manner, responsibility for the protection of natural features may be passed on from management to the public.

The natural resources management plan will be subject to the review and approval of the State Historic Preservation Officer and a professional archeologist.

None of the proposed actions will involve the manipulation of Lehman Orchard and Aqueduct or Rhodes Cabin, nominated to the National Register. According to the Procedure of the Advisory Council on Historic Preservation, an identification of resources and a determination of effect will be applied to the proposed action. Historic and archeological resources of significance or potential significance will be preserved, in compliance with Executive Order 11593 and the National Historic Preservation Act of 1966.

ADVERSE EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

Test plot markers on the walls of the cave will leave small, permanent scars.

The enforced carrying capacity of the cave does result in inconvenience and irritation if the visitor must wait or turn back because the cave is determined to be full.

THE RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

All the research proposals involve no short-term uses of the environment. Studies on algae and mosses and on biota will contribute to a long-lived natural cave environment. An inventory of groundwater resources, development of a Water Resources Management Plan, and seismic investigations will serve future needs. Soils and biotic studies are needed to make informed management decisions. Long-term observations on changing vegetation patterns are the result of man-caused disturbances and fire suppression, but these changes have not been evaluated in the light of vegetation management. Air quality evaluations will have no immediate effect on the natural systems, but may have a bearing on future decisions affecting them.

The proposed management actions are necessary manipulative techniques to preserve a natural cave environment. The long-term benefits of limited cave use will be accompanied by visitor inconvenience, especially during holiday weekends when alternative recreation sites may be occupied.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION

There will be no irreversible losses of resources. Rather than destruction of biotic, geologic, or cultural resources, the proposed action will, in fact, assist in ensuring their preservation.

No action alternative

This alternative would continue current management practices. This is essentially a status quo plan, lacking a specific logical approach to managing or controlling natural resources of the area.

Soils in the monument support native pinyon pine and Utah juniper; thus far, vegetation patterns and densities in the plant communities have undergone changes without informed vegetation management. The monument's 640 acres would continue to be managed as an extension of adjacent national forest lands.

Algae and mosses would proliferate and imbed into the formative cave material with largely unknown effects.

A biological inventory of the cave interior would identify native and exotic species present. A seismic and geological survey would determine potential visitor use hazards. Without these data under the no action alternative, the caves would not be managed in the most effective way to perpetuate geological and ecological conditions. Without a Water Resource Management Plan, the monument may possibly fail to comply with Federal laws.

On the positive side no test-plot markers would be used in cave walls with a no action alternative. Visitor use might be nearly unlimited, as human carrying capacities would remain unknown. However, a conservative Superintendent might overly restrict the number of visitors without having specific information about the impact of humans on cave resources.

CONSULTATION AND COORDINATION

This revised NRMP resulted largely from the efforts of Superintendent David E. Moore and his staff at Lehman Caves. Dr. Milton C. Kolipinski, coordinator of NRMPs in the Service's Western Regional Office in San Francisco assisted in compiling review comments and editing this document. During the preparation of the NRMP and environmental assessment, sources outside the Service were consulted for their knowledge and recommendations.

As an adjacent landholder on all sides of the monument, the Forest Service manages the Snake Valley watershed and the Wheeler Peak Scenic Area. Forest Service staff work alongside monument staff at the visitor center, and resource management consultation is regularly exchanged. An aerial survey in 1971 on forest infestation and disease included monument lands.

Dr. Nellie Stark of Desert Research Institute conducted a study on air relationships within the cave. In addition, Dr. Stark found that "out of the 200 lights studied in the caves, 77.5% had algae, 20.5% had mosses, and 75.0% had visible evidence of fungi."

Dr. Raymond Lynn of Utah State University has conducted a preliminary study on control measures for algal growth in the cave. On June 17, 1974, Dr. Lynn set up six test plots in two locations off the main trail. Herbicides in varying concentrations were applied, and plot readings were taken on a subsequent field trip on August 12, 1974.

The folowing organizations will receive informational copies of this document:

Bureau of Land Management
  Ely District Office
Forest Service
  Humboldt National Forest
Nevada Fish and Game Department
  Spring Creek Rearing Station
State Health Department
State Historic Preservation Officer
Baker Ranch
School of Natural Order

Any letters of comment received will be reviewed by the Superintendent for implementation. Copies of the assessment and public comments will be available at Lehman Caves National Monument and the Western Regional Office.