Caves and Karst of the National Park Service

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Abstract

With such famous caves as Wind, Jewel, Carlsbad, and Mammoth, the public has long associated caves with the National Park Service. However, the diversity of "lesser-known" caves within the National Park Service is also quite high. Of the 281 National Park Service sites that contain significant natural resources, 76 contain caves and an additional 24 contain karst. This makes caves and karst one of the more dominant ecosystem/habitat/resource types within the entire National Park System. Seven of the eight cave types are represented, including several that may be considered the "type specimen." Managers, when evaluating potential impacts to caves, should evaluate both the individual resources within the particular cave and the cave's relationship to the regional and national environment. Karst and cave processes are not always easily recognizable. For instance, although no soluble rocks are exposed, karst processes are likely to play a significant role in one of the primary resource threats affecting Oklahoma's Chickasaw National Recreation Area. For many years, researchers have investigated the park's springs to determine their characteristics and to explain their slow disappearance. These researchers employed traditional groundwater investigative techniques, only to find conflicting and inconclusive results. However, many traditional groundwater techniques do not work well in karst terrains. Karst research at Chickasaw National Recreation Area may lead to a better understanding of the springs and the cause of the impacts to these significant park resources. This is but one example highlighting the importance of an inventory of cave and karst resources within the National Park Service.

Introduction

There are 384 units of the National Park Service as of March 2001. There is at least one unit located in every state within the United States except Delaware. Of these, 281 (73 percent) are considered to contain significant natural resources. Additionally, there are National Park Service sites in Guam, Puerto Rico, the Virgin Islands, and American Samoa. This represents a diverse array of parks and associated ecosystems.

There are also diverse caves within the National Park Service. With such famous caves as Wind, Jewel, Carlsbad, and Mammoth, the public has long associated caves with the National Park Service. However, the diversity of "lesser-known" caves within the National Park Service is also quite high. Of the 281 sites that contain significant natural resources, 81 contain caves and an additional 39 contain karst. Therefore, a total of 43 percent of all National Park Service sites containing significant natural resources contain caves and/or karst This makes caves and karst one of the more dominant ecosystem/habitat/resource types within the entire National Park System.

Definitions

Cave- the Federal Cave Resources Protection Act defines a cave as "any naturally occurring void, cavity, recess, or system of interconnected passages beneath the surface of the earth or within a cliff or ledge, including any cave resource therein, and which is large enough to permit a person to enter, whether the entrance is excavated or naturally formed." For the purpose of this paper, the term "cave" is less inclusive. Caves are reserved for only

those features meeting the above definition and having a sufficient length-to-entrance width ratio whereas the cave's environment is noticeably altered or modified. This ecological component was included to eliminate the many rockshelters, overhangs and other small recesses that have no real "cave climate" or "cave ecology." With this more restricted definition, caves must have sufficient length so that the humidity, temperature, ambient light, and other environmental factors differentiate it from surface environments. This is of course subjective, however two generalizations can often be made: the cave must reach a point of near or total darkness, and if a suspected "cave" contains organisms that are known to be cave-adapted, or partially cave-adapted organisms, it probably is a "cave." With such a definition, this list does not include parks, such as Canyon de Chelly National Monument or Chattahoochee River National Recreation Area, that contain features called "caves," but do not fit the definition of caves used in this paper. Although many of these cave-like features would fit under the broader definition of a cave as defined by the Federal Cave Resources Protection Act, these features do not serve the ecological role that a "true" cave does. These features may be more properly called "rockshelters." Additionally, since the broader definition has no clear minimum bounds or standard, the reporting of the number of caves within any park would be nearly impossible. If one were to include rockshelters, the number of parks containing caves and the total number of caves within National Park System would dramatically increase.

Karst- for the purposes of this paper, surface morphological features such as sinkholes, sinking streams, and the like are not used as a definitions of karst, aspects that are more functional are utilized. Quinlan *et al*. (1991) defines a karst aquifer as "an aquifer in which flow of water is or can be appreciable through one or more of the following: joints, faults, bedding planes, and cavities—any or all of which have been enlarged by dissolution of bedrock." In his investigation, Quinlan found that dye injected into nearly any carbonate rock experienced non-Darcian flow typical of karst aquifers, even those carbonate rocks that did not contain any outward appearances of being karst. Due to these findings, karst is defined as any carbonate, sulfate, or other rock capable of relatively rapid dissolution by water under naturally occurring pH ranges. No attempt was made to define the minimum thickness of rock necessary to be considered karst. However, minor in-fillings and veins were not included.

Discussion

In the discussion of which parks contain karst, one must also consider the vertical location of the karst. For instance, some definitions would only include rocks exposed on the surface. However, for the purposes of this paper a broader interpretation is used. A park is included if the karst rock unit is shallow enough to enable it to interact with surface or groundwater. The inclusion of buried rock units where there are no surface exposures was due to four reasons:

(1) land management within the National Park Service is inclusive of a vertical column extending from the atmosphere above the surface portion of the park down through towards the center of the earth;

(2) just because a rock unit is not exposed does not mean that these rocks are not having an effect upon surface and subsurface processes. For instance, non-soluble rocks overlie a significant portion of Mammoth Cave, the longest known cave in the world. However, undeniably, the underlying cave is having an effect upon surface and subsurface water.

(3) if there are surface or subsurface processes occurring that are affected by covered karst, then there is a possibility that land managers could unknowingly alter, modify, or interrupt these processes out of ignorance.

(4) it is a natural process within a National Park Service unit, and the National Park Service has been directed to manage natural processes.

The following list summarizes the parks that contain caves or karst. This is a dynamic list due to at least eight reasons:

(1) many National Park Service areas have not been adequately inventoried for cave and karst resources;

(2) some National Park Service managers consider caves as a relatively minor resource within the National Park Service; therefore, adequate attention may not have been placed upon caves or karst;

(3) many people knowledgeable about the presence of caves closely guard these secrets;

(4) historically, caves were viewed more as recreational resources and less so as natural laboratories for scientific research; therefore, the quantity of published references and research within National Park Service caves is often sparse;

(5) cave and karst processes are often not as well understood by National Park Service managers compared with many other park resources and processes; so therefore, park management's ability to recognize cave and karst processes is hampered;

(6) caves are still being discovered;

(7) since some cave types are formed by rapid processes, new caves have formed since parks have been established;

(8) people's definition of a cave varies, so that the number of caves within an area varies depending upon the source.

The references included in the following list are not intended to be a complete list, quite the contrary. The listed references were included to provide examples of some of the sources that author used to confirm the presence of caves or karst on National Park Service lands. The many references used to confirm which parks do not contain caves or karst have not been listed. The author attempted not to rely on only one source of information but rather obtain published material that collaborated other information, such as personal interviews. Occasionally, sources conflicted. In these situations, the author evaluated and judged the validity of data.

The author has been maintaining an inventory of National Park Service areas containing caves and karst for a number of years. Such an inventory is never "complete." Therefore, the author would appreciate any additions or corrections.

Table 1. **National Park Service Caves/Karst: Cave Sites**

Park	Cave Type	**# of Caves**	**References**
Abraham Lincoln Birthplace National Historic Site	(Ls)	001	42
Acadia National Park	(Er)	012	101,112
Amistad National Recreation Area	(Ls)	030	83,92,203
Aniakchak National Monument or Preserve	(La)	001	PV
Apostle Islands National Lakeshore	(Er)	075	136
Badlands National Park[§]	(Er)	050	25,29,71
Bandelier National Monument	(La)	002	42,46,47,181
Bering Land Bridge National Preserve	(La,Er)	113	64,113
Big Bend National Park	(Ls)	007	34,117
Big South Fork National River and Recreation Area	(Ls)	001	36
Bighorn Canyon National Recreation Area[I]	(Ls)	001	19,69,93
Bryce Canyon National Park	(Ls)	001	35,57,148,193
Buffalo National River	(Ls)	275	11,72,135
Carlsbad Caverns National Park	(Ls)	095	9,42,67,68,74,75,76,144
Catoctin Mountain National Park	(Te)	002	50
Cedar Breaks National Monument	(Ls)	001	103
Channel Islands National Park	(Er)	369	PV
Chesapeake and Ohio Canal National Historical Park	(Ls)	011	50,73,124
Chickamauga & Chattanooga National Military Park	(Ls)	013	42,89
Coronado National Memorial	(Ls)	009	2,133
Crater Lake National Park	(Er)	051	4,90
Craters of the Moon National Monument	(La)	130	23,29,173
Cumberland Gap National Historical Park	(Ls)	015	94
Death Valley National Park	(Ls)	002	21,24,187
Denali National Park	(Ls,Gl)	003	53
Dinosaur National Monument	(Ls,Er)	005	29,100,146,191
El Malpais National Monument	(La)	240	42,131,139,167
Fort Donelson National Battlefield	(Ls)	001	PV
Gates of the Arctic National Park	(Ls)	007	178
Glacier National Park	(Ls)	006	19,20,29,105
Glacier Bay National Park or Preserve	(Gl)	001	198
Golden Gate National Recreational Area	(Er)	119	154

Golden Spike National Historic Site[&]	(Ls)	004	71,202
Grand Canyon National Park	(Ls)	400	82,121,152
Grand Teton National Park	(Ls)	017	29,69,103
Great Basin National Park	(Ls)	014	71
Great Smoky Mountains National Park	(Ls)	010	3,42,54,110,126,137,138,162,201
Guadalupe Mountains National Park	(Ls)	025	42,67,68,74,75,76,130
Haleakala National Park	(La)	024	111
Harpers Ferry National Historical Park[I]	(Ls)	001	32,42,66,79
Hawaii Volcanoes National Park	(La)	155	18,38,55,56,80,127,147
Jewel Cave National Monument	(Ls)	012	29,43,49,142,200
Kalaupapa National Historical Park	(La)	016	61,165
Kaloko-Honokohau National Historical Park	(La)	004	18
Kenai Fjords National Park	(Er)	012	185
Kings Canyon National Park	(Ls)	012	37
Lava Beds National Monument	(La)	399	5,51,60,91,104,132,158,170,195
Mammoth Cave National Park	(Ls)	350	42,143
Mojave National Park	(Ls,La)	010	1,96,196
Montezuma Castle National Monument	(Ls)	001	129
Mount Rainier National Park	(Gl)	005	6,28,40,42,62,102,168
Natchez Trace Parkway	(Ls)	005	122,177
Noatak National Preserve	(Ls)	004	163
Obed Wild and Scenic River	(Er)	001	184
Olympic National Park	(Er)	003	26,42,62,102,182
Oregon Caves National Monument	(Ls)	012	85,118,119,157
Ozark National Scenic Riverways	(Ls)	320	14,141
Pea Ridge National Military Park	(Ls)	001	11,175
Pinnacles National Monument	(Te)	006	42,45,123,134
Point Reyes National Seashore	(Er)	139	154
Pu'uhonua o Honaunau National Historical Park	(La)	006	18
Redwood National and State Parks	(Er)	002	172
Rocky Mountain National Park	(Gl)	001	29,42,140
Russell Cave National Monument	(Ls)	010	58,77
Saint Croix National Scenic Riverway	(Er)	012	44
San Juan Island National Historic Site	(Ls)	001	31,42,62,102
Sequoia National Park	(Ls)	188	37
Shenandoah National Park	(Ls)	001	12
Stones River National Battlefield	(Ls)	001	120
Sunset Crater Volcano National Monument	(La)	001	10,169
Theodore Roosevelt National Park[§]	(Er)	006	29,42,159
Timpanogas Cave National Monument	(Ls)	006	29,71
Valley Forge National Historical Park	(Ls)	005	88,128,176,204
War in the Pacific National Historical Park	(La)	012	39
Wilsons Creek National Battlefield	(Ls)	002	11
Wind Cave National Park	(Ls)	015	29,43,49,71,108,142
Wrangell-St. Elias National Park	(Ls,Gl)	008	7,52,99,106,155,161
Wupatki National Monument	(Er)	012	145,160

Yellowstone National Park	(Ls,La)	006	69,107
Yosemite National Park	(Te/Ls)	014	154
Yukon-Charley Rivers National Preserve	(Ls)	006	156,178
TOTAL 81 Parks and 3,926 Caves			+

Table 2. **National Park Service Caves/Karst: Karst Areas With No Known Caves**

Park	References
Agate Fossil Beds National Monument	29
Alibates Flint Quarries National Monument	13,116,150,194
Antietam National Battlefield	197
Big Cypress National Preserve	81,95,114
Biscayne National Park	30,86,97
Bluestone National Scenic River	174
Buck Island Reef National Monument	115
Canaveral National Seashore[#]	48,179,180
Castillo De San Marcos National Monument[#]	171
Chickasaw National Recreation Area	22,63,183,189,199
Colonial National Historical Park	151
Cumberland Island National Seashore[#]	59
De Soto National Memorial[#]	8,186
Delaware Water Gap National Recreation Area	166
Denali National Preserve	53
Devils Tower National Monument[¥]	29,42
Dry Tortugas National Park	115,164
Everglades National Park	15,27,78,98,190,192
Fort Caroline National Memorial[#]	17,171
Fort Frederica National Monument[#]	PV
Fort Matanzas National Monument[#]	171
Fort Pulaski National Monument[#]	PV
Fort Sumter National Monument[#]	PV
Fossil Butte National Monument	29
Gates of the Arctic National Preserve	178
Lake Mead National Recreation Area	16,153,188
Lake Meredith National Recreation Area	13,116,150,194
Lyndon B. Johnson National Historical Park[#]	87
National Park of American Somoa	115
New River Gorge National River	174
Ross Lake National Recreation Area[¥]	42,65,102
Saguaro National Park	84
Salt River Bay National Historic Park & Ecological Preserve	115
Timucuan Ecological and Historic Preserve[#]	17,125
Tonto National Monument	70
Tuzigoot National Monument	129
Virgin Islands National Park	42,115
Wrangell-St. Elias National Preserve	52,99,106,155,161
Zion National Park	41
TOTAL 39 parks containing karst, however with no known caves	

THERE ARE 120 NATIONAL PARK SERVICE UNITS CONTAINING CAVES OR KARST

KEY:
Ls- Solution Caves
La- Lava Tubes/Lava Caves
Gl- Ices Cave (caves in summit ice caps or glaciers)
Ta- Talus Caves
Te- Tectonic Caves
Er- Erosion Caves

† = Carbonate rocks consists of active or recent coral reefs
# = Buried karst - no karst feature visible on surface
¥ = Very minor or very thin lens of soluble rocks
i = Cave is within the park but the entrance is located outside park boundaries
£ = Contains cave-like karst features but unknown how long, may not be an actual cave
? = Small cave like erosion features, may be too small to be called a "cave," however contains bats.
Œ = May no longer be present due to glacial melting.
PV = Partially verified at time of press due to misplaced or incomplete reference.

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Criteria (viii): The property Caves of Aggtelek and Slovak Karst, while typical of many karst localities in Europe, is distinctive in its great number (with 712 recorded at time of inscription) of different types of caves found in a concentrated area. Geological processes causing karst features to be buried by sediment and then later reactivated or exhumed provide evidence pertaining to the geologic history of the last tens of millions of years.Â However, in both countries most of the surface area of the property has National Park designation. Aggtelek Karst is administered by the Aggtelek National Park Directorate and the Slovak Karst is managed by the Slovak Karst National Park Directorate (surface) and Slovak Caves Administration (caves). Wet season in Everglades National Park, Florida. Photo by Glenn Gardner. Introduction. Water flows from a cave entrance at Ozark National Scenic Riverways, Missouri.Â Karst is a type of landscape where the dissolving of the bedrock has created sinkholes, sinking streams, caves, springs, and other characteristic features. Karst is associated with soluble rock types such as limestone, marble, and gypsum. In general, a typical karst landscape forms when much of the water falling on the surface interacts with and enters the subsurface through cracks, fractures, and holes that have been dissolved into the bedrock.Â The following is a partial list of National Park Service units that include karst landscapes: Buffalo National River, Arkansasâ€"[Geodiversity Atlas] [Park Home]. Karst and caves form the backbone of many NSW national parks and give rise to some of their most spectacular scenery. Karst conservation areas are true living landscapes that bear witness to centuries of interplay between the forces of climate, geology and topology. One particularly notable NSW karst environment is Jenolan Caves in the Blue Mountains â€“ the oldest discovered open caves in the world. Parks in which this environment is found. Abercrombie Karst Conservation Reserve. High Plains area in Kosciuszko National Park. Jenolan Karst Conservation Reserve. Kosciuszko National Park. Southern Blue Mountains area in Blue Mountains National Park. Wombeyan Karst Conservation Reserve. Yarrangobilly area in Kosciuszko National Park. Links. Geodiversity, karst and caves. Poster - Caves and Karst of the National Park System. Caves and Karst in the U.S. National Park System. A poster prepared by the NPS Geological Resources Division showing the location of all park units (c. 2012) on a base map of the karst geology of the United States. A full version of this poster is available for download: [https://irma.nps.gov/DataStore/Reference/Profile/2239537]. Related Links. Caves by the Numbersâ€"http://www.caverbob.com/. Glacier Ice Caves. Last updated: April 14, 2021. Explore the sparkling limestone caves of the Mole Creek Caves. Guided tours showcase the striking formations amongst the underground network of caves, sinkholes, gorges, streams and springs.Â The spectacular show caves in the Mole Creek Karst National Park have been delighting visitors for decades, come and experience the underground landscapes of Marakoopa and King Solomons Caves. Read more. There are a number of locations around the state that offer a unique setting for your wedding ceremony.