Determining recreational visitor carrying capacity: The case of Black Canyon at Lake Mead National Recreation Area

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Determining Recreational Visitor Carrying Capacity:
The Case of Black Canyon
at Lake Mead National Recreation Area

A Thesis submitted as partial satisfaction
of the requirement for the degree of
Bachelor of Arts
in
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Las Vegas

by
Kenneth C Forman
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Thesis Advisor: Dr. Dennis Soden
Environmental Studies
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ABSTRACT

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Lake Mead and Lake Mohave, created by Hoover and Davis Dams respectively, were combined, along with much of the surrounding area, into the Lake Mead National Recreation Area in 1964. The enabling legislation is specific about the duty the National Park Service has to the public to create and maintain this, and other, national recreation areas for the benefit of the visitors, the environment, and future generations. By investigating human impacts on the physical environment (water quality, litter, etc.) and by querying park users on their opinions (with respect to crowding, visitor behavior, etc.), insight can be gained about appropriate visitor use levels. This paper explores research now being conducted to find the best visitor carrying capacity for the recreation area, using a case study of the Black Canyon area of Lake Mead National Recreation Area.
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Dr. Dennis Soden from University of Nevada, Las Vegas, served as my mentor and instructor on this project. Without his instruction and encouragement, I don't think I could have finished this paper or my degree.

Most importantly I'd like to thank my wife, Aileen Forman. Without her support and understanding, this thesis would have been little more than academic speculation.
Introduction

As National Park use increases in America, the need for careful park management continues to increase as well. Many parks are approaching levels of visitation that severely tax the park's ability to recover from its use, and some have already surpassed it (Cahn 1969). The Lake Mead National Recreation Area (LMNRA) on the Nevada/Arizona border is one such unit of the National Park Service which is experiencing heavy visitation. Visitor use in 1992, for example, "reached 9.34 million, and visitation is expected to increase at a rate that will reach 12 million by the year 2000," for the Lake Mead unit (Holland 1993). Except for times of world influencing events, such as World War II, the Korean War or OPEC's oil embargo in the early 80's, Lake Mead has experienced steadily increasing visitation (see Figure 1). Without proper management, the unique environment of LMNRA will be overwhelmed by boaters, fishermen and other recreational visitors.

There is no doubt that resources, both natural and man made, are limited. We can choose to ignore the lessons learned from Yosemite and Yellowstone National Parks, that overuse equals abuse, or we can manage our parks for sustainability (Foresta, 1984).
Figure 1. Number of Visitors to LMNRA from 1937 to 1993. (Source: U.S. Department of the Interior, 1993)
Managing Lake Mead National Recreation Area

The Colorado River system was the first drainage basin in the United States in which the concept of multiple use of water was attempted: e.g., power development, irrigation, recreation, flood control, and navigation. The first major development of the Colorado began in 1928, when Congress passed the Boulder Canyon Project Act. The act authorized the construction of Boulder (now Hoover) Dam, a multipurpose water-storage project that was a major engineering feat of its time. Since its completion in 1936, the dam and Lake Mead, which it created with its impounded waters, have become major tourist attractions. For twenty-eight years the Bureau of Reclamation managed the lake, but this bureau was never intended to oversee recreational facilities. In 1964 a Federal act established the Lake Mead National Recreation Area in order to establish a more adequate basis for effective administration of such an area for the public benefit. The act pronounced that the National Park Service (NPS) would be responsible for the area's administration and charged the NPS to manage the lake for the purpose of: "...general...public recreation, benefit, and use, and in a manner that will preserve, develop, and enhance...the recreation potential and in a manner that will preserve the scenic, historic, scientific, and other important features of the area..." (U.S.
Department of Interior 1993, 3). The terms of this enabling legislation forces park managers into the precarious position of balancing user's needs and desires with those of resource protection and preservation. Indeed, even if the enabling legislation did not include this mandate, superintendents at LMNRA, and other parks, should be concerned with overcrowding. In these times of increased use, how do you provide for general public recreation while preserving for the future? How do we manage an ecosystem with fixed carrying capacity?

The first step is to determine the carrying capacity of the park.

"Carrying capacity" was originally a stockman's term describing the number of cows a stretch of country could sustain without exceeding the capacity of the range; [Lowell] Sumner, [a Park Service wildlife specialist] was the first to apply the concept to people and to recognize that the wilderness could not accommodate unlimited numbers. He felt that it was the function of wilderness managers to "determine in advance the probable maximum permissible use, short of impairment, of all wilderness areas." Sumner's premise was eventually accepted, but no one has ever presented a park superintendent with a practical means of determining, on the basis of measurable and supportable calculations, the 'saturation point' of his area (Everhart 1985, 100).

In 1942, when Sumner presented this challenge, the means to determine carrying capacity was not yet available. Advanced data collecting techniques, statistical analysis and computer systems have now allowed us to make more accurate predictions based on measurable and supportable calculations.

Once the carrying capacity of a given area is known,
future management plan alternatives can take that capacity into account. Lake Mead NRA is no exception. Before the general management plan (GMP) is changed to the role and impact of consider carrying capacity, the superintendent must first make the decision to change it. Although this may seem like an obvious statement, there are no provisions in the LMNRA or any other park unit's enabling legislation for a regular review of the GMP. Unlike many other federal government actions, there is no "trigger" that initiates a review.

The reasons for redoing a plan might be political, administrative or economic. A superintendent may feel pressure from concessionaires or park users to increase (or decrease) accessibility to various parts of the park. Mining lobbies or other business interests cause local congressmen to apply political pressure on park administrators. The reasons can be as varied as the park system itself. Without legal triggers, management plan reviews and rewrites are vulnerable to such political posturing. Sometimes a conscientious superintendent will review the GMP, and investigate resource protection. It is sad to note, however, that resource protection often takes a back seat to other, more mundane reasons (Freemuth 1991).

Increased incident reports and complaints from LMNRA users prompted park superintendent Alan O'Neil to scrutinize
the existing GMP. Public safety and resource protection seem to have been his primary concern. Keeping this in mind, he hired Jim Holland as Park Planner for LMNRA based on his experience conducting a visitor-use survey of Glen Canyon NRA a few years earlier. Although the Glen Canyon survey was intended only as a pilot study and was never considered in the park’s GMP, it did demonstrate a method of "determin[ing] in advance the probable maximum permissible use, short of impairment" (Everhart 1985, 100), of the park. Although LMNRA is much larger than Glen Canyon NRA, it was determined that similar methods could be used to quantify carrying capacity of the area. As a result, a carrying capacity study of LMNRA was initiated on Memorial Day, 1993, and continued until Labor Day, 1994, encompassing two summer seasons and one winter season in order to confirm that use patterns between winter and summer seasons varied significantly.

**Determining Carrying Capacity at LMNRA**

The Lake Mead National Recreation Area encompasses Lake Mead, Lake Mojave, and the surrounding lands, totaling 1,501,216 acres (see Figure 2). Most areas of the lakes are accessible only by boat or plane and much of the surrounding land has limited or restricted access. Where back country roads do exist, their condition prevents most people from ever using them. On the other hand, improved areas such as
Boulder Beach, Callville Bay, and other marinas on Lake Mead, and Katherine’s Landing, Cottonwood Cove, and Willow Beach on Lake Mojave are readily accessible to anyone with a car and the inclination to visit. The heaviest use is, therefore, concentrated at the public marinas, beaches, and launch ramps while most of the park is sparsely used. By dividing the park into twenty-four zones (see Figure 3), the visitor-use study was designed to isolate distinct use patterns, heavily and lightly impacted parts of the park, and other trouble spots.

The carrying capacity of any recreational lake is dependent on many factors, but can be broken down into three major categories. These are:

1. Environmental impact (water quality, shoreline and lake litter, sensitive area protection, and wildlife management).

2. Public safety (boat crowding, and shoreline crowding).

3. Public perception (urban, rural, or primitive experiences).
Figure 2. Lake Mead National Recreation Area.
(Source: U.S. Department of the Interior, 1993)
Figure 3. LMNRA Management Zones. (Source: U.S. Department of the Interior, 1993)
Each of these factors limits the maximum use of a given area. Once all these limits are established, the restricting factor (the one with the smallest capacity) acts as an indicator of overuse. For example, analysis may determine that an area has shoreline camp sites for 200 people, but the water quality is reduced to unacceptable levels if that many people use the area. If all other factors (i.e., other environmental impacts or public perceptions) indicate that more than 200 people would not significantly affect the area, then, in this case, water quality would be the limiting factor. If increased use is desired, effort can be applied to increasing the limiting factor's capacity.

How the LMNRA Carrying Capacity Project Was Designed

In order to best quantify and compare data, surveys were conducted on specific dates between Memorial Day, 1993 and Labor Day, 1994. Water quality, shoreline litter density, boat crowding and visitor perception assessments attempted to determine the current human impact on the lake. Each of these assessments, though independently taken, occurred on the same (or nearby) date. This allowed investigators to explore the interrelationship among the information. For example, if a specific date's boat census indicated a high number of boaters, but the visitor perception survey showed that most people's enjoyment was not significantly reduced by the number
of boats on the lake, we can conclude that, barring other factors, there were not too many boats on the water. This situation is common in the summer, when visitors expect to see large numbers of boaters. On some summer holidays, there were more than 1300 boats on either lake, yet no more than 12% of those surveyed felt "[t]here was an unsafe number of boats on the water." At other times, the opposite is true. Even though winter use is drastically lower, less than one-quarter of summer use, many more users thought there were too many boats.
Thesis Limitations

The carrying capacity project encompasses literally thousands of pages of data covering each assessment for each set on each of the twenty-six days of the survey period. Once completed, analysis of the data set will provide a better understanding of the park's potential, both as an ecosystem and a recreational area. The scope of the final document is, obviously, too vast for this thesis. As a consequence I have chosen to limit my analysis to Black Canyon, a unique and scenic area which provides a case study from which generalizations about the entire visitor-use survey can be made.

Black Canyon

The northernmost thirteen miles of Lake Mohave, stretching from immediately below Hoover Dam to Willow Beach (see Figure 3), is a canyon of unexpected beauty. Black Canyon, considered by some to be the most scenic part of LMNRA, may be the most sensitive to overuse. Black Canyon supports an unusual ecosystem including two endangered fishes, the razorback sucker (*Xyrauchen texanus*), and the bonytailed chub (*Gila elegans*), the surrounding desert, and washes which serve as grazing land for big horn sheep and other animals which find their natural habitat within the canyon washes.
In some places, steep high walls stretch over two hundred feet above the river's surface. Most of the canyon is narrow, never growing wider than a few hundred feet. The water is cold (about 54° year 'round) and shallow (rarely deeper than ten feet). This makes the canyon ideal for trout fishing. In contrast to the cold water, Black Canyon also boasts several hot springs at the river's edge or a short distance up side canyons.

The area is only accessible by motor boat from the south. Willow Beach, located at the southern end of Black Canyon, is one of only three improved launch ramps on Lake Mojave. The closest gas dock to the area is Cottonwood Cove, about 30 miles away. Canoes and kayaks can launch from a special dock, controlled by the Bureau of Reclamation (BOR), operators of Hoover Dam, near the base of the dam. The BOR limits the number of boats launched from their dock to only 30 per day.

There are three foot trails providing access to the river via Gold Strike Canyon, Boy Scout Canyon or White Rock Canyon. All these canyons have hot springs in them, and attract hikers who will undertake the strenuous trek to soak in their waters.

Some extremists may suggest that closing Black Canyon to visitors would be the most effective management choice. While this may indeed help the ecosystem, it denies the potential visitor the wonder of this unique place and ignores the mandate given to the Park Service by the enabling legislation.
(i.e., providing public recreation and use). Instead, perhaps a careful study of the impacts of human visitation can determine the best way to preserve and share this natural resource.

Visitor Characteristics

According to visitor surveys, the average visitor to Black Canyon is male, Caucasian, about 34 years old, employed full time, has some college education, and tends to have a middle to upper class income (greater than $50,000 annually). He came to the lake 8.8 times for a total of 19.9 days in the last twelve months. The average visitor has been boating for a little over 15 years, but only 29.3% of the respondents have ever taken a boater safety course (see Table 1).

One hundred percent were at satisfied or extremely satisfied with the natural scenery. (This was expected since Black Canyon is quite scenic.) Visitors tended to rate highly their opportunity to relax, opportunity to experience nature and solitude, and the overall quality of their visit.
<table>
<thead>
<tr>
<th>Table 1. Black Canyon Visitor Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Race</td>
</tr>
<tr>
<td>Average Age</td>
</tr>
<tr>
<td>Employment</td>
</tr>
<tr>
<td>Education Level</td>
</tr>
<tr>
<td>Income Level</td>
</tr>
<tr>
<td>Average Annual Visitation</td>
</tr>
<tr>
<td>Average Total Days Visited</td>
</tr>
<tr>
<td>Average Boating Experience</td>
</tr>
<tr>
<td>Percent of Boaters That Have</td>
</tr>
<tr>
<td>Taken a Boater Safety Course</td>
</tr>
</tbody>
</table>
Limiting Factors of Carrying Capacity: Environmental Impact

A number of factors go into determining carrying capacity. Federal regulations serve as the limiting factors in water quality and litter density, while safety constraints limit boat crowding. Public perception and desired experience provide indicators for determining appropriate visitation levels that match the public's "desired experience" in relationship to the area.

Water Quality

Environmental impact is the first factor for consideration of Black Canyon's carrying capacity. It is best represented by water quality. Vital to fish, birds and other wildlife, the quality of the water flowing through the canyon serves as an excellent indicator of the overall health of the ecosystem.

Water samples taken during the survey testify to the cleanliness of the river. Tests for fecal coliform (FC) indicate levels far below Federal regulations for clean water (200 units per 100 ml of water). Most of the counts for the two zones were below 10; however, on two occasions the count exceeded 100 (124, 156), and once it reached 240. All three of these high counts occurred in Zone 9 at Gold Strike Canyon. This is the only place in Black Canyon where the National Park
Service maintains a back country toilet. On the survey date when the FC count reached 240, the toilet had been tipped over into the river. The other two days with high counts were heavy use, summer holiday weekends. The next highest recorded counts were 60 or below (see Table 2).

<table>
<thead>
<tr>
<th>FC Count</th>
<th>Occurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>1 - 10</td>
<td>29</td>
</tr>
<tr>
<td>11 - 50</td>
<td>20</td>
</tr>
<tr>
<td>51 - 100</td>
<td>1</td>
</tr>
<tr>
<td>101 - 200</td>
<td>2</td>
</tr>
<tr>
<td>&lt; 200</td>
<td>1</td>
</tr>
</tbody>
</table>

Due to the cleanliness of the river in Black Canyon, it seems unlikely that water quality provides the limiting factor to visitation. It would seem that no immediate mitigation is necessary to maintain water quality in the area. It is interesting to note that if the NPS removed the one toilet, water quality in the canyon would not likely degrade; it may even prevent large increases in FC counts due to improper care of the facility.
Shoreline and Lake Litter

Shoreline litter, a potential human impact, is not easily measured. While there are currently no federal regulations on the amount or density of litter along our rivers, common sense can guide our decisions.

Shore litter potentially affects the local environment in two ways. It can contribute to an overall degradation of the natural surroundings and it worsens visitor perception of the area and the park.

Even though the public may feel there is some problem, as with the water quality, shoreline litter in Black Canyon doesn't seem to be a serious problem (see Table 3).

Table 3.

<table>
<thead>
<tr>
<th>Litter Count</th>
<th>Occurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>1 - 10</td>
<td>35</td>
</tr>
<tr>
<td>11 - 20</td>
<td>4</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>1</td>
</tr>
</tbody>
</table>

Considering that shoreline litter counts for other parts of Lake Mojave regularly exceed 100 pieces per 300 square feet (in one site the count reached 600 pieces per 300 square feet), Black Canyon is relatively clean. However, depending on area visitor perception, even counts as low as 10 pieces
per 300 square feet may be too high. Over 71% of area visitors surveyed stated that shoreline litter was at least a slight problem.

Lake litter determinations are perhaps even more elusive than shoreline litter measurements. No attempt was made to measure the amount of litter in Black Canyon. It is likely that the current of the Colorado River would carry any water borne litter out of the canyon and into the wider portions of Lake Mojave. Over 67% of the visitors surveyed felt that there was at least some slight problem with litter in the lake. As a result, the litter situation is one that deserves further investigation. (Note: Out of the ten impacts visitors were asked to rate as a "slight" to "very serious problem" or "not a problem," shoreline litter and lake litter rated as the two greatest problems.)

In this era of tightening budgets and shrinking funds, prevention may be cheaper than clean up. Many western lakes provide large trash bags to boaters when they launch, thus promoting the "pack it in, pack it out" mentality. If the NPS provided bags to boaters, perhaps any litter problem, or perception of a litter problem, could be circumvented.

**Sensitive Area Protection and Wildlife Management**

While Black Canyon does have some sensitive environments, the limited access to the canyon helps prevent excessive
stress to those environments. The hot springs and washes found along the canyon support healthy ecosystems and frequent flash-floods help to flush those areas clean of human impact. The established plant and animal communities are adapted to this natural flooding. Protection of sensitive areas and/or local wildlife does not seem to be necessary therefore, there need not be any limits to visitation other than those posed by the inaccessibility of the canyon.
Limiting Factors of Carrying Capacity: Public Safety

When considering the public carrying capacity of an area, there are two physical limiting factors: boat crowding on the lake, and shoreline camping space. Measuring these two factors is difficult in most situations, but in Black Canyon, there are certain constraints that make the job a little easier.

Boat Crowding

Boat crowding on many western lakes — and Lake Mojave is no exception — is a factor of the types of boats found there and the area they require. Undoubtedly the primary potential boating recreation on Lake Mojave is water skiing (see Table 4).

Table 4.

<table>
<thead>
<tr>
<th>Boat Type</th>
<th>Percent of total boats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runabout (&lt; 24ft)</td>
<td>50.5</td>
</tr>
<tr>
<td>Cruiser (&gt; 24ft)</td>
<td>5.0</td>
</tr>
<tr>
<td>Pontoon Boat</td>
<td>4.5</td>
</tr>
<tr>
<td>House Boat</td>
<td>5.2</td>
</tr>
<tr>
<td>Sail Boat</td>
<td>0.5</td>
</tr>
<tr>
<td>Hot Boat</td>
<td>1.3</td>
</tr>
<tr>
<td>PWC</td>
<td>24.2</td>
</tr>
<tr>
<td>Canoe or Kayak</td>
<td>8.8</td>
</tr>
<tr>
<td>Other miscellaneous boats</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>
While not all runabouts, cruisers or hot boats are towing skiers, they all could be. In Black Canyon however, skiing is prohibited due to the water temperature and the uncertain nature of the water level. (Skiing is not allowed until mile marker 43, eleven miles south of Willow Beach.)

Shoreline Crowding

Another potential limiting factor is the amount of shoreline camp space available. Black Canyon has few good campsites (see Table 5).

When Lake Mohave's water level is high, the number of campsites decreases from about 26 to about 14. The water level in Black Canyon is influenced by many things. When the power demand from Hoover Dam is great, the flow through the system is correspondingly increased. This increase temporarily raises the water level in the canyon. High and low fluctuations often occur within a twenty-four hour period. Seasonal demands also affect the release rate, as well as irrigation needs from down river agriculture. When Lake Mojave is used for water storage, the level is higher, but again, seasonal power demands from Davis Dam, which makes Lake Mojave, may increase the release rate. If the water level of Lake Mojave is so unpredictable, we must manage for the highest level, so the total number of campsites in Black Canyon is 14.
Table 5.

Black Canyon Cove Names and Campsites

<table>
<thead>
<tr>
<th>Mile Marker</th>
<th>Cove Name</th>
<th>Shore Camp Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High water, Low water</td>
</tr>
<tr>
<td>62</td>
<td>197a Sauna Cave N¹</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>197a Rain Caves N</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Hot Water Fall A²</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>197 Nevada Hot Springs N</td>
<td>0</td>
</tr>
<tr>
<td>61</td>
<td>196 Lost Man Hot Springs A</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>195 Two Mile Hot Springs N</td>
<td>0</td>
</tr>
<tr>
<td>60</td>
<td>Unnamed Hot Spring N</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>194 White Rock Canyon A</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>193 Ringbolt Hot Springs A</td>
<td>10</td>
</tr>
<tr>
<td>62</td>
<td>192 The Chute</td>
<td>0</td>
</tr>
<tr>
<td>58</td>
<td>Unnamed Hot Spring N</td>
<td>0</td>
</tr>
<tr>
<td>57</td>
<td>Unnamed Coves A,N</td>
<td>2</td>
</tr>
<tr>
<td>56</td>
<td>191 Crane’s Nest Wash A</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Unnamed Cove N</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>

¹ Cove located on the Nevada side of the lake.
² Cove located on the Arizona side of the lake.
³ The ten campsites found at mile marker 60 are between White Rock Canyon and Ringbolt Hot Springs.

The average party size visiting the area is 6.2 people. This indicates that the number of people that can camp overnight in the canyon is about 86.8 people. About half of the people in the area (49.3%) indicated that they were camping overnight (the other half being day visitors). This means that the total visitation limit based solely on
shoreline space is about 174 people or about 28 parties (at an average of 6.2 people per party).

Research also indicates that these parties have an average of 2.1 watercraft each party. By dividing the number of parties allowed in the area by the average number of boats per party we can find a limit to the number of boats that can be allowed in the area without adversely affecting shoreline crowding. About 14 boats could use the area based on this calculation. If 8.8% of the boats on the lake are canoes or kayaks (the only boats launched from the Bureau of Reclamation dock), only about one or two human powered craft should use the area. The Bureau of Reclamation's limit of 30 human powered craft far exceeds this indicated limit. Since these canoe trips tend to be "overnighters," these boaters are the most severely impacted by shoreline crowding.

Mitigating this impact requires that the total number of boats using the area be reduced or the total amount of shoreline space be increased. Much of the nine miles from Hoover Dam to Willow Beach is confined by steep cliff faces, some over 200 feet tall. The beach space that currently exists is all that is likely to exist without drastically altering the character of the canyon.

Reducing the number of boats using the area is the only mitigation method available; but, while this could be fairly easily accomplished, it is not likely to be favorably received
by the public. Black Canyon is a prime trout fishing area and the lure of the hot springs brings many other visitors. Increasing foot access by improving existing trails or building new ones will only increase the number of overnight visitors. As long as major access to the canyon is by boat, some control is possible. Obviously some measure of management is needed here.
Limiting Factors of Carrying Capacity: Public Perception

The intangible concept of visitor perception is perhaps the most difficult factor to quantitize. A two part visitor-use survey (Appendix A) was designed to investigate public perception. The first part, an on-site interview conducted by university students, investigated elements like party size, type and number of boats used, group activities, use-patterns (i.e., where did the party go on the lake, where did they camp, etc.). It also examined the group's perception of crowding, both on the lake and on the shoreline.

The second part of the survey, a mail back questionnaire, asked the respondents to consider less-tangible concepts such as overall satisfaction, and feelings of personal safety. It also asked the visitor to rate their opinion of certain problems on the lake (i.e., "Noise at the campsite," or "Litter in the lake"), and whether or not they favor certain suggested management actions (i.e., "Expand the number of marina slips," or "Zone the waters to provide specific uses at specific places"). The survey also asked for standard demographic information, such as education, race or ethnic group, and income.

The overall results of the survey were consistent with the expectations of visitor perception. Visitors to Black Canyon were generally pleased with their visit. On a scale of
1 to 10, visitor responses averaged to 8.6 when asked on site. (The mail back questionnaire also asked for an overall rating from 1 to 10. These responses were only slightly lower, averaging to 8.4.) It would appear that the public enjoys water recreation at Lake Mojave.

Interviewers asked park users to rate the crowding at various locations or facilities they may have used. A scale from one to nine (see Table 6) allowed respondents to choose between slight personal variations.

Table 6.

Crowding Scale and Results

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Slightly</td>
<td>Moderately</td>
<td>Extremely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crowded</td>
<td>Crowded</td>
<td>Crowded</td>
<td>Crowded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average Response

2.3 At the launch ramp/marina at the start of your trip
2.4 Out on the lake while boating
2.5 Along the shoreline areas that you used
2.3 At the launch ramp/marina when you stopped boating
1.8 At the boat pumpout facilities

The results indicate that nowhere is crowding a primary concern for users of Black Canyon. However, please note that the highest rating is the crowding along the shoreline areas.
This is just another indication that shoreline crowding is the primary limiting factor to carrying capacity of the area.

On the mail back questionnaire, visitors were asked to indicate if they favor or oppose various potential management actions considered for LMNRA. The most frequent responses (in percent) suggest that the public favors:

1. Providing aggressive enforcement of safety rules and regulations (63.6%),
2. Expanding the number of marina slips (53.6%), and
3. Establishing "off limits" zones to protect sensitive resources (50.9%).

Actions which the public opposes are:

1. Requiring payment of an entrance fee for access to LMNRA (58.9%),
2. Restricting further facility development and expansion (55.7%),
3. Limiting the number of boats allowed on the water at any one time (54.4%), and
4. Zoning the waters to provide specific uses at specific places (50.9%).

The general public's perception, it would seem, is one of a lake that can be used by increasing numbers of people, with little care for the affected environment. Half of the visitors wanted to protect sensitive areas while half (not necessarily the other half) did not want the lake zoned to prevent certain activities in certain areas. This seeming contradiction arises from the conflicting notions of personal freedom and environmental awareness. "I want to do my thing,
but if too many people are doing their thing, someone must be limited. Just don't limit me." Discussions with Park Planner Jim Holland imply that the NPS would like to embrace the public's preferences in matters of park management. It is the public's park, after all, and if it is not managed for the public, then why is a public park? Unfortunately the masses do not tend to have adequate knowledge of environmental, ecological, or political concerns. Park planners must adhere to their initial goal of preserving the scenic, historic, scientific, and other important features of the area while working within the framework of our modern government and its bureaucratic system.
Conclusions

Visitation to the various units to the National Park System will certainly increase over time. It may increase to such a level that drastic measures will need to be taken to preserve natural, scenic, historic, scientific, or other important features of the area. Otherwise these important features will be ground under the heels of unintending users or washed away by a multitude of motor boat or personal watercraft wakes. The administrators of Lake Mead National Recreation Area are in an enviable position. They have at their disposal management techniques that may prevent over abuse before it happens.

By determining recreational carrying capacity of specific areas of the park, administrators can mitigate problems to reduce environmental impact, or take steps to reduce (or increase) visitation in these areas. A number of potential limiting factors to carrying capacity exist at LMNRA. Any one of them may be the crucial factor, the bottleneck, that limits maximum allowable use in specific areas. Black Canyon, the nine miles between Hoover Dam and Willow Beach, on Lake Mojave, is one of these specific areas that was investigated. Table 7 summarizes the results of a sixteen month long survey that probed each of these potential factors. Without a doubt, shoreline crowding in the scenic canyon is the most important limiting factor to the area's carrying capacity.
Table 7.

Black Canyon Carrying Capacity Limiting Factors

<table>
<thead>
<tr>
<th>Potential factors</th>
<th>Limiting factor in Black Canyon?</th>
<th>Importance Rating¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water quality</td>
<td>Yes/No²</td>
<td>3rd</td>
</tr>
<tr>
<td>Shoreline litter</td>
<td>Yes/No²</td>
<td>2nd</td>
</tr>
<tr>
<td>Lake litter</td>
<td>No</td>
<td>-3-3</td>
</tr>
<tr>
<td>Sensitive area protection</td>
<td>No</td>
<td>-3-3</td>
</tr>
<tr>
<td>Wildlife management</td>
<td>No</td>
<td>-3-3</td>
</tr>
<tr>
<td>Public safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boat crowding</td>
<td>No</td>
<td>-3-3</td>
</tr>
<tr>
<td>Shoreline crowding</td>
<td>Yes</td>
<td>1st</td>
</tr>
<tr>
<td>Public perception</td>
<td>No</td>
<td>-3-3</td>
</tr>
</tbody>
</table>

¹ Importance Rating is based on the actual limits caused by potential factors.
² Important factors, but not severe enough to warrant immediate action.
³ Negligible impact.

By greatly reducing the number of human powered boats launched from the Bureau of Reclamation’s Hoover Dam dock, or by restricting area access to motorboats from the south, park administrators can reduce the area’s visitation to that of its carrying capacity. Another choice, albeit highly infeasible, would be to increase the amount of shoreline camping space available. This plan would require either removing scenic cliffs and washes (perhaps with explosives) to increase the number of campsites, or maintain the lake’s water level relatively low to keep from flooding existing low lying campsites. Since both of these latter alternatives present
much greater problems than they solve, neither are acceptable actions.

After shoreline crowding, water quality and shoreline litter pose the greatest limits to visitor carrying capacity. It is advisable for the Park Service to monitor these aspects of visitor impact, but if limits are successfully imposed on visitation to Black Canyon, they are not likely to become significant in the future.

Americans love to love their National Parks to death. We now have the opportunity and the tools to prevent this from happening. The management decisions that lie ahead for administrators of the Lake Mead National Recreation Area must apply all available knowledge and techniques. Without conscientious and considerate care of the park, administrators become little more than entrance fee collectors.

The Environmental Studies Program at UNLV teaches a "wholistic" approach to environmental management. Graduating students leave the program with the skills necessary to visualize the interrelationships between biological, chemical, sociological, and political aspects of a given situation. Wildlife, ecosystem, and recreational management go hand in hand with social and political pressures. This thesis addressed these diverse facets of visitor carrying capacity.

Proper land use management requires flexible thinking. If managers are to learn such flexible thinking so they may
respond to constantly changing conditions -- not only the physical conditions that experience seasonal changes, but socio-political conditions that vary with changing political climates -- they must have an interdisciplinary background. They also need the proper tools to correctly analyze conditions. An in-depth study analyzing the "whole picture" (such as this study of Black Canyon) is the proper tool to make proper decisions.
References Cited


Additional Readings


Figure 1. Number of Visitors to LMNRA from 1937 to 1993.
(Source: U.S. Department of the Interior, 1993)

Figure 2. Lake Mead National Recreation Area.
(Source: U.S. Department of the Interior, 1993)

Figure 3. LMNRA Management Zones.
(Source: U.S. Department of the Interior, 1993)
Appendix A
Hello, I am (name and affiliation, i.e. NFS or UNLV student, etc.). We are conducting interviews with visitors to Lake Mead National Recreation Area. The information visitors give us will be used to help park managers better serve the visiting public. You have been selected as part of a random sample of park visitors to participate in this survey. If you choose to participate, everything you tell us will be kept strictly confidential. The survey will only take about five minutes to complete. Although we would greatly appreciate your help, you are free to decline this interview with no penalty to yourself or your party.

May we proceed with the interview?

Yes  GO TO QUESTION 1  No  GO TO REFUSAL SHEET

1. Is this your first visit to Lake Mead National Recreation Area?
   ___ Yes  ___ No

2. Where is your principal home residence?
   _______ (state)  _________ (town)  _________ (zip)

3. How many people are in your group?  _______ people

4. Do you have a pet with you at the lake?
   ___ No  ___ Yes  If yes, what type of pet?  _____________

5. How many watercraft does your group have with you at the lake?  ______

SHOW LIST OF WATERCRAFT TYPES

5a. What type(s) of watercraft is it?  WRITE IN THE NUMBER OF EACH BOAT TYPE LISTED

5b. What is the length of your boat(s)?  WRITE IN THE LENGTH OF EACH BOAT

# /LENGTH  # /LENGTH

___/___ Runabout (< 24 ft)  ___/___ Waverunner/jetski
___/___ Cruiser (> 24 ft)  ___/___ Sailboard
___/___ Pontoon boat  ___/___ Canoe or kayak
___/___ House boat  ___/___ Other
___/___ Sailboat  ___/___ Other
___/___ Hot boat  ___/___ Other

5c. Did you rent any boat or watercraft?
   ___ No  ___ Yes  If yes, did you rent it in the park?  ___ No  ___ Yes

5d. Does your boat have a marine toilet or porta potty?  ___ No  ___ Yes

ASK IF YES What type is it?
   ___ Built-in head with holding tank  RECORD CAPACITY  _______ gallons
   ___ Portable unit (Porta Potty)  RECORD CAPACITY  _______ gallons
SHOW MAP TO RESPONDENT

8. Next we would like to know which areas of the lake you have used. On the map below, please indicate all of the zones you and your party visited in Lake Mead National Recreation Area.

PROBE RESPONDENT TO MAKE SURE YOU HAVE IDENTIFIED ALL ZONES VISITED. PLACE A CHECK MARK ON THE MAP IN THE FIRST BOX NEXT TO EACH ZONE VISITED

8a. What zone did you spend the most time in? __________

8b. (ASK IN ROVING SURVEYS ONLY) Where did you launch your boat or begin your trip on the lake?

______________________________ RECORD LOCATION

8c. (ASK ONLY TO USERS WHO CAMPED ALONG THE SHORELINE) Where did you camp?

______________________________ RECORD COVE NAME(S) IF KNOWN

ALSO WRITE IN THE NUMBER OF NIGHTS CAMPED IN EACH ZONE IN THE SECOND BOX NEXT TO THE ZONE NUMBER ON THE MAP

8d. What zone did you enjoy the most? __________

Why? ____________________________________

8e. Did you experience problems in any zone? ___ No ___ Yes

IF YES which zone(s)? ________________________________

and what type of problem? __________________________

LAKE MEAD NATIONAL RECREATION AREA

[LAKE MEAD]

LAKE USE ZONES

SCALE IN MILES

[Diagram of Lake Mead National Recreation Area with zones numbered 10 to 24, major landmarks labeled, and check marks indicating selected zones]
9. On a scale of one to ten, how would you rate your overall experience at Lake Mead National Recreation Area, with a rating of 10 being the best possible experience, and a rating of 1 being the worst possible experience you can imagine? 

______ Rating

10. How did the number of people you saw at the lake today compare with what you expected to see?

______ A lot less than you expected
______ A little less than you expected
______ About what you expected
______ A little more than you expected
______ A lot more than you expected
______ You didn't really have any expectations

11. What sanitation methods did you use during your visit to the lake? CHECK ALL THAT APPLY

______ built in head/toilet on boat
______ porta potty
______ shoreline or floating restrooms in backcountry or beach areas
______ return to marinas/launch ramps to use restrooms
______ pit toilets along shoreline
______ other shoreline sites
______ other (specify________________________)

12. Using the following scale, how would you describe the boating conditions at each of the following areas during your visit to Lake Mead National Recreation Area?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Slightly</td>
<td>Moderately</td>
<td>Extremely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crowded</td>
<td>Crowded</td>
<td>Crowded</td>
<td>Crowded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

______ At the launch ramp/marina at the start of your trip
______ Out on the lake while boating
______ Along the shoreline areas that you used
______ At the launch ramp/marina when you stopped boating
______ At the boat pumpout facilities

13. Was there anything you expected to do during your visit but were not able to do?

______ No  ____ Yes (IF YES COMPLETE 13A AND 13B)

13a. What did you expect to do?

________________________

13b. What preventing you from doing it?

________________________

Thank you for completing this boater survey. We would also like to ask you some additional questions after you have returned home from your visit. Would you be willing to give us your name and address so we can mail you a follow-up survey to complete at your convenience? Again, this information will be kept confidential.

ASK RESPONDENT TO PROVIDE NAME AND MAILING ADDRESS ON LABEL SHEET. AFTER COLLECTING ADDRESS AND CHECKING FOR LEGIBILITY, HAND COPY OF SURVEY AND RETURN ENVELOPE TO RESPONDENT. THANK RESPONDENT AND TERMINATE INTERVIEW.

RECORD BY OBSERVATION: Sex of respondent?  ____ male  ____ female  Apparent age?  ____
Lake Mead National Recreation Area Visitor Survey

Part 1. Your Boating Experience

The following questions are about your previous boating experience at Lake Mead National Recreation Area and other places. While answering these questions, please remember that Lake Mead NRA includes both Lake Mead and Lake Mohave.

1. How often did you come to Lake Mead National Recreation Area during the last twelve months?
   - Number of trips
   - Total number of days

2. In what year did you make your first visit to Lake Mead National Recreation Area? ________ Year

3. Since you first visited Lake Mead NRA, has the overall quality of the trip? (Check one)
   - Improved
   - Remained the same
   - Gotten Worse

   If you checked "improved" or "gotten worse," what is the major reason?

4. How many days in total did you spend boating during the last 12 months? ________ Days

5. What lakes or water resources (including rivers, bays, etc.) do you normally use for boating? (Please check all that apply)
   - Lake Mead
   - Lake Mohave
   - Lake Havasu
   - Lake Powell
   - Other (Please list all that you can think of)

6. In one sentence, could you tell us why you choose to visit Lake Mead National Recreation Area?

7. Have you ever deliberately visited Lake Mead National Recreation Area during low use periods to avoid large numbers of visitors or traffic at specific locations?
   - No
   - Yes

   7a. If yes, which periods and locations did you avoid?

8. How many years have you been a boater? ________ Years

9. Have you ever taken a boater safety course?
   - No
   - Yes
Part 2. A Description of Your Trip

The following questions are about your experience at Lake Mead National Recreation Area during the visit when we contacted you.

1. Please characterize your group and list the number of individuals in each age group?

<table>
<thead>
<tr>
<th>Group Type (check one)</th>
<th># Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family</td>
<td>under 12</td>
</tr>
<tr>
<td>Multiple families</td>
<td>13 - 18</td>
</tr>
<tr>
<td>Family and friends</td>
<td>19 - 25</td>
</tr>
<tr>
<td>Friends</td>
<td>26 - 40</td>
</tr>
<tr>
<td>Organized outing group</td>
<td>41 - 54</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>55 and over</td>
</tr>
</tbody>
</table>

2. How would you describe the following aspects of your visit to Lake Mead National Recreation Area? Please circle the number that best describes how you felt about each aspect that you experienced.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Extremely Satisfied</th>
<th>Satisfied</th>
<th>Undecided</th>
<th>Unsatisfied</th>
<th>Extremely Unsatisfied</th>
<th>Didn’t Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Scenery</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Opportunity to experience nature</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Opportunity to experience solitude</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Opportunity to participate in activities</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Opportunity to relax</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Attitude of National Park Service rangers</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Attitude of other park employees</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Behavior of park visitors</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Quality of visitor information</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Quality of exhibits and other</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>educational materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of concessioner food services</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Quality of concessioner lodging</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Quality of concessioner retail stores</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Upkeep of facilities within the area</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Overall quality of your visit</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

3. On a scale of one to ten, how would you rate your overall experience at Lake Mead National Recreation Area that day, with a rating of 10 being the best possible experience, and a rating of 1 being the worst possible experience you can imagine?

______ Rating

4. What did you like **best** about your visit to the lake?

5. What did you like **least** about your visit to the lake?
6. How do you feel about the numbers of people you encountered during your visit?

- Would like to have seen a lot more people
- Would like to have seen a few more people
- Neither too many nor too few people
- Would like to have seen a few less people
- Would like to have seen a lot less people

7. Using the following scale, please circle the number that best describes how the number of boaters at the lake affected your overall boating experience?

<table>
<thead>
<tr>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased my enjoyment</td>
<td>No effect</td>
<td>Reduced my enjoyment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Below are some statements about boating at Lake Mead National Recreation Area. For each statement, please circle the response that best describes your feelings about your visit to the lake on the day we interviewed you.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I cannot imagine a better boating trip</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>I avoided my favorite parts of the lake because there were too many boats there</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>I thoroughly enjoyed my boat trip that day</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>I stayed off the lake during parts of the day because there were too many boats on the lake</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>My boating trip was not as enjoyable as I expected it to be</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>There was an unsafe number of boats on the water</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>I thought the lake and its surroundings were in good condition</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>Other boats came closer to my boat than I like</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>All boat operators should be tested and licensed like motor vehicle operators are</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>I found the navigational aids provided at Lake Mead National Recreation Area helpful</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>I was bothered by aircraft flying overhead during my visit to the lake</td>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
</tbody>
</table>
I do not want to go on any more boat trips like that one
Strongly Agree Agree Undecided Disagree Strongly Disagree
SA A U D SD

The noise of other boats reduced my enjoyment on the lake
SA A U D SD

My boat trip was well worth the money I spent to take it
SA A U D SD

There were too many houseboats on the lake
SA A U D SD

There are adequate law enforcement patrols at Lake Mead National Recreation Area
SA A U D SD

If I had known what it was going to be like that trip, I would not have come to the lake
SA A U D SD

Boating conditions on the lake were safe
SA A U D SD

I was disappointed with some aspects of my boat trip
SA A U D SD

The number of boats on the lake reduced my enjoyment
SA A U D SD

I nearly had an accident on the lake because of crowded conditions
SA A U D SD

People should be required to take a boating safety course before being allowed to operate a boat
SA A U D SD

I was bothered by jet skis cutting too close to my boat
SA A U D SD

While at Lake Mead National Recreation Area, I felt like my personal safety and security were at risk
SA A U D SD

IF YOU AGREE WITH THIS STATEMENT
Can you describe why you felt that way:

The behavior of other boaters interfered with the quality of my boating experience
SA A U D SD

IF YOU AGREE WITH THIS STATEMENT
Can you describe how the behavior of other boaters interfered with your experience:
I did not like the amount of time I had to wait to get on the water

Strongly Agree Agree Undecided Disagree Strongly Disagree
SA   A   U   D   SD

IF YOU AGREE WITH THIS STATEMENT
How much time did you have to wait?

_________

How long are you willing to wait?

_________

I did not participate in some boating activities because of crowded conditions at the lake

SA   A   U   D   SD

IF YOU AGREE WITH THIS STATEMENT
Which activity(ies) did you give up?

____________________

Did you observe any unsafe boating situations on the lake?

_____ No  _____ Yes

IF YES, could you describe them?

____________________

9. How much did your group spend on your trip to Lake Mead National Recreation Area? Please estimate the amounts your group spent both inside the park and within a day's drive outside of the park for each of the following categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Outside Park (within a day's drive of the park)</th>
<th>Inside Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lodging (motels, campgrounds, etc.)</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>Meals in restaurants</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>Gasoline</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>Food/Ice/Beverages</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>Retail purchases</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>Boat rentals</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>Other (specify ________________)</td>
<td>_______</td>
<td>_______</td>
</tr>
</tbody>
</table>
10. Information about various impacts you may have noticed at the lake would be helpful to lake managers. To what extent did you find each of the following to be a problem during your visit to Lake Mead National Recreation Area?

<table>
<thead>
<tr>
<th>Impact</th>
<th>Not a Problem</th>
<th>Slight Problem</th>
<th>Moderate Problem</th>
<th>Serious Problem</th>
<th>Very Serious Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broken glass</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Litter in the lake</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Polluted water</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Personal watercraft operating too close</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Litter along the shore</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Improper disposal of human wastes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Noise at the campsite</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Conflicts with other boaters for beach space</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Conflicts with houseboats over beach space</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Other impacts (please specify)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Part 3. Managing Lake Mead National Recreation Area

1. Do you feel that more controls are needed to prevent conflicts from occurring between lake users?

   _____ No  _____ Yes

   If yes, what conflicts and how should they be managed?

      ________________________________

2. Do you feel that more controls are needed to prevent damage to the environment by visitors at Lake Mead National Recreation Area?

   _____ No  _____ Yes

   If yes, what kinds of environmental damage did you see and how should they be controlled?

      ________________________________
3. Are there certain activities or services that should be offered at Lake Mead National Recreation Area that currently are not?

___ No  ___ Yes

If yes, what kinds of activities or services?

4. Given the conditions you observed at the lake, how would you feel about each of the following potential management actions for Lake Mead National Recreation Area?

<table>
<thead>
<tr>
<th>Potential Management Action</th>
<th>Strongly Favor</th>
<th>Favor</th>
<th>Undecided</th>
<th>Oppose</th>
<th>Strongly Oppose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide more improved public access to the lake</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Zone the waters to provide specific uses at specific places</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Limit the number of boats allowed on the water at any one time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Provide aggressive enforcement of safety rules and regulations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Restrict the number of houseboats allowed on the lake</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Expand the number of marina slips</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Restrict personal watercraft use to designated areas only</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Establish 'off limits' zones to protect sensitive resources</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Restrict further facility development and expansion</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Require payment of an entrance fee for access to Lake Mead National Recreation Area</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

5. Are there any other restrictions or management improvements you would suggest for Lake Mead National Recreation Area?
Part 4. Visitor Information

The following information will help us to better understand the characteristics of Lake Mead Visitors and to make predictions about lake use in the future. Please respond to the questions only about yourself and remember that all of your answers are strictly confidential.

1. Which of the following indicates your level of education (check one)?

   - 8th grade or less
   - 9th to 11th grade
   - 12th grade (high school graduate)
   - 13-15 years (some college)
   - 16 years (college graduate)
   - 17+ years (some graduate work)
   - Masters, Doctoral, or Professional Degree

2. Which of the following best describes your employment status?

   - Employed, full time
   - Employed, part time
   - Retired, but working full time
   - Retired, working part time
   - Retired, not working
   - Homemaker
   - Unemployed
   - Student
   - Other (Please specify)

2a. If you are employed, what kind of work do you do?

3. Please tell us which of the following best indicates your race or ethnic group?

   - Native American or Alaskan Native
   - Asian or Pacific Islander
   - African-American
   - Hispanic
   - White, not of Hispanic origin
   - Other

4. Which of the following best describes your household income before taxes?

   - Less than $10,000
   - $10,000 - $19,999
   - $20,000 - $29,999
   - $30,000 - $39,999
   - $40,000 - $49,999
   - $50,000 - $59,999
   - $60,000 - $69,999
   - $70,000 - $79,999
   - $80,000 - $89,999
   - $90,000 - $99,999
   - $100,000 - $149,999
   - $150,000 and above

5. Does any member of your boating group have a disability or impairment?

   - No
   - Yes
   - If yes, what type or types?

6. Is there anything else you and your group would like to tell us about your visit to Lake Mead National Recreation Area? Attach additional pages if needed.

Thanks again for your help. Please place your completed questionnaire in the envelope provided and drop it in any mailbox.