



USE LEVELS AND CROWDING IN THE GRAND CANYON
Bo Shelby and Joyce M. Nielsen
Colorado River Research Program Final Report

Technical Report No. 3

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COLORADO RIVER RESEARCH PROGRAM

Grand Canyon National Park
Grand Canyon, Arizona 86023

The Colorado River Research Program was initiated by the National Park Service in 1974 to secure scientific data to provide a factual basis for the development and the implementation of a plan for appropriate visitor-use of the Colorado River from Lee's Ferry to Grand Wash Cliffs and for the effective management of the natural and cultural resources within the Inner Canyons. The intensified research program consists of a series of interdisciplinary investigations that deal with the resources of the riparian and the aquatic zones and with the visitor-uses including river-running, camping, hiking, and sight-seeing of these resources, as well as the impact of use and upstream development upon canyon resources and visitor enjoyment.

Final reports that result from these studies will be reproduced in a series of Program Bulletins that will be supplemented by technical articles published as Program Contributions in scientific journals.

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USE LEVELS AND CROWDING
IN THE GRAND CANYON

RIVER CONTACT STUDY
FINAL REPORT

PART III

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PREFACE TO PART III

The River Contact Study was contracted in April, 1974, to assess the sociological effects of different management alternatives on the nature and quality of the river experience in the Grand Canyon. Initially, the project was focused on the effects of motorized travel and different use levels. In the spring of 1975, concern over the differences in private and commercial use prompted the Park Service to include this issue within the scope of the study.

The final report is organized into four major sections. The first is a description of the study design and implementation, including measurement techniques, sampling, and data collection. Parts II, III, and IV consider in turn the motor-oar, use levels, and private-commercial issues. The sections are bound separately to make them more easily available to those with specific interests.

ABSTRACT

Use levels affect the character of the river experience in terms of river and attraction site encounters. Most river travelers define the Canyon and their trip in terms of wilderness, and most perceive the Canyon as uncrowded. However, perception of crowding is independent of actual contact levels, and user satisfaction (trip rating) is unrelated to either perceived crowding or number of encounters. The lack of relationship among these variables is attributed to the lack of agreement about how crowded the Canyon "should" be. Those who thought the Canyon was crowded had different wilderness ideologies from those who didn't, and satisfaction was based on the personal benefits, social atmosphere, and wilderness character provided by the trip.

Management of the crowding situation can most effectively be aimed at controlling the character of the river experience. Choosing one use level or another requires definition of the kind of experience to be provided and selection of an appropriate contact level. The possibilities for scheduling and simulation are discussed.

ACKNOWLEDGEMENTS

Our ability to conduct the River Contact Study was based primarily on the cooperation of the people who run the Colorado River. Outfitters accommodated the project by allowing observers to accompany trips, boatmen were helpful on a day-to-day basis on the river, and passengers filled out questionnaires with only minor grumbling. Special thanks are due to Bob and Jessica Elliott of ARTA Southwest, who made possible the motor-oar combination trips. Private river runners were especially gracious in allowing observers to become a part of their trips.

Our observers turned in reliable trip reports under sometimes trying circumstances. Mary Strand, Mike Delaney, Susan Shoulders, and Randy Fout did the bulk of the data collecting, while Bill Fowkes, Dan Spray, David Schoen, Dick Skeene, Barb Farhar, David Lillie, Bev Shafer, Peter Marshall, Sig Krane, and Kim Rea rounded out the trip schedule, sometimes on short notice.

The staff of Grand Canyon National Park made many contributions to the project. Bob Yearout and his people in the Inner Canyon Office provided invaluable information from their files. Roy Johnson's commitment to the integrity of the project was crucial at several points, and he proved to be a resourceful research strategist as well as an able liason with the Park Service.

The members of our research advisory board, Drs. William Catton, John Krutilla, George Stankey, and Karl Taeuber, provided professional advice, suggestions, and criticism. Tom Heberlein at the University of Wisconsin contributed his expertise and enthusiasm on an informal basis. Thanks also go to Jeff Ingram, who provided assistance on historical aspects of the motor-oar controversy.

First rate support was provided by Charlotte Purvis and Susan Leavy, who without extensive complaining turned semi-legible scrawl into finished manuscripts. They created a competent and congenial office atmosphere on which the project relied heavily. Barbara Douglas provided editorial assistance, and we made extensive use of her ability to insure that written material actually conveyed what we meant to say.

Finally, some sociological issues seem to be of interest to almost everyone. When it was discovered that we were doing research in the Canyon, many people had ideas and opinions which they shared with us. Some of these thoughts were clever and insightful and others weren't, but they were fun to talk about and the project benefitted from our exposure to all of them.

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FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Finding: Different use levels have a pervasive effect on the character of the Grand Canyon experience in terms of river and attraction site contacts. Use level does not yet affect campsite contacts, but does affect the number of adjustments for crowding made by trip leaders.

pp. 5-21

Finding: The vast majority (90%) of river travelers define the Canyon and their trip in terms of wilderness. Thirty percent see the Canyon as crowded, but this is unrelated to the number of people they saw during their trip.

pp. 21-25

Finding: Satisfaction levels in the Canyon are high, with most (85%) rating their trip as "excellent" or "perfect." Satisfaction is not related to perceived crowding or actual density.

p. 25

Finding: The lack of relationship between contacts, perceived crowding, and satisfaction is attributed to the lack of agreement about how crowded the Canyon "should" be. Most river runners are making the trip for the first time; over half didn't know what to expect in terms of contacts with other groups, and there was little consensus among those who had some expectation.

p. 27

Finding: Those who thought the Canyon was crowded were no more likely to have a great deal of wilderness experience. However, they were more likely to: 1) favor small groups, non-motorized travel and low numbers of encounters; 2) be willing to "pay" for solitude, and 3) perceive the Canyon as more affected by use.

pp. 27-31

Finding: Satisfaction with trips is based on the personal benefits, social atmosphere, and wilderness character provided by the trip.

pp. 31-33

Conclusion: Management of the crowding situation on the river can best be aimed at controlling the character of the experience (contacts among groups). Numerous shortcomings of the "satisfaction" model make it unrealistic to attempt to manage for satisfaction. Control is achieved by regulating the size, number, length, and kind of trips leaving Lee's Ferry.

pp. 35-37

Conclusion: Choosing a use level requires definition of the kind of experience to be provided and selection of a contact level "appropriate" for that experience. Public involvement could be helpful in selecting an appropriate use level.

pp. 37-39

Conclusion: Use tends to be concentrated both in certain areas and at certain times. Scheduling in these high use areas would help maximize total use while minimizing the concentrations which cause crowding. A simulation model might help predict the effects of different scheduling alternatives.

pp. 40-49

Recommendation: Public involvement should include collection of data which would help establish contact norms for the desired experience (e.g., wilderness) in the Canyon.

p. 39

Recommendation: Information on "intended" trip schedules should be collected as soon as possible. Such non-obligatory scheduling would have a number of benefits and would cost very little.

pp. 40-41

Recommendation: User-days should be used only as a means of dividing the "user-pie." Weekly and daily launch limits (in terms of trips) are needed to insure acceptable contact levels.

p. 43

Recommendation: The Park Service should explore the possibility of using computer simulation to determine the effects of management alternatives which cannot be explored using current data. Simulations should be checked against "real world" data.

p. 49

INTRODUCTION*

The dramatic increase in outdoor recreation during the past ten years has created a number of problems for wilderness resource managers.¹ In providing for use of these resources in the face of growing demand, managers have become increasingly concerned with use capacities of several kinds. The first of these is physical capacity, which is reached when all trails and camps are full and no more people can enter an area. The second is biological capacity, which is the number of people an area can tolerate without degradation of its natural resources.

Finally, managers have become concerned with how visitors affect one another. Because one of the primary attractions of wilderness is the opportunity for solitude, over-crowding can detract from the quality of the experience. It is necessary, then, to determine the number of people for whom a high quality experience can be provided.

The specific issues explored here arose in relation to the Grand Canyon section of the Colorado River. The river flows through the Canyon for 280 miles from Lee's Ferry to the Grand Wash Cliffs and provides an incomparable outdoor-whitewater experience. River trips through the Canyon begin at Lee's Ferry, Arizona. The first point at which passengers can debark is Phantom Ranch, 88 miles downstream, but most go on to either Diamond Creek (mile 225, the first point where boats can be taken out) or Pierce's Ferry (mile 280). Motorized trips float the river on large (30-40 feet) pontoon rafts, and take between five and eleven days to traverse the Canyon. Oar powered craft are generally smaller (15-25 feet) and take a longer time (12-18 days) to make the trip.

At night, trips camp on natural beaches along the river. During the day, they travel on the river and make stops at "visitor attraction sites." These are places of scientific, historical, or aesthetic interest. They include side Canyons, tributary streams, waterfalls, swimming holes, etc. The number and length of these stops varies from one trip to another.

*The introduction contains a description of river trips which is repeated at the beginning of Parts II, III, and IV. Readers who have seen other parts of the report may want to skip to the next section, "The Effects of Different Use Levels in the Canyon."

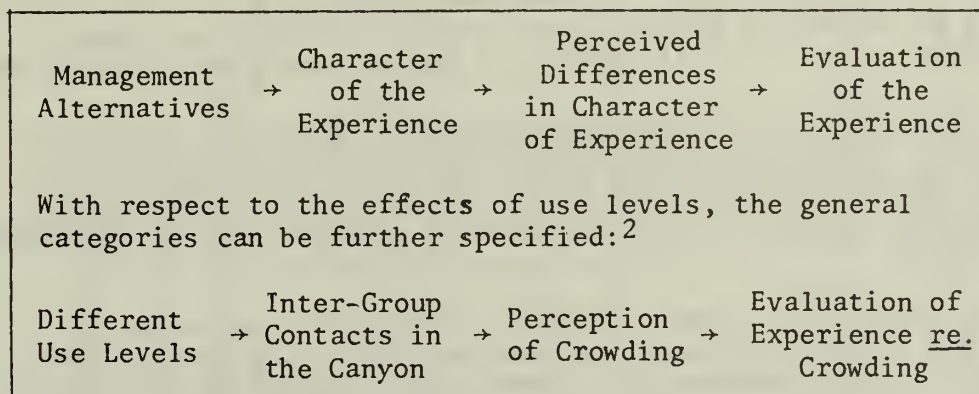
Although first run in 1869 by the Powell Expedition, the Grand Canyon had seen less than 100 river runners by 1950, and by 1959 there were still less than 100 people making the trip each year. During the sixties and early seventies, however, use grew at an average rate of 59% a year. In 1965, only 547 people ran the river; by 1972, the number had grown to 16,428 (see Nash, 1973:271 for further documentation).

The problem of use levels in the Canyon did not arise as a single issue but, rather, within the context of a situation involving a number of other factors. The Park Service at Grand Canyon initially allowed commercial outfitters to run the river essentially unregulated. The unchecked growth in use which developed created a number of problems, one of which was crowding. The issue developed along with the motor-oar issue, and its history is discussed in the motor-oar section (Part II) of this report.

Use levels on the river are currently regulated in terms of user-days (one visitor on the river for any part of a day). Interim limits exist for user-days per season, percentages of user-days which can be utilized per month, and number of people who can leave Lee's Ferry per day.

THE EFFECTS OF DIFFERENT USE LEVELS IN THE CANYON

The overall aim of this study is to find out how different management alternatives affect the river experience. The general model for understanding this phenomenon contains four elements:



There are three major research questions suggested by this discussion. First, how do different use levels affect contact rates among groups? Second, how are different contact rates perceived by river travelers in terms of "crowding?" Third, how does crowding affect people's evaluation of the river experience?

USE LEVELS AND CONTACTS

During the study period, use levels ranged from 80 to 940 people per week leaving Lee's Ferry. Assuming these weekly use levels were maintained throughout a twenty-week season (multiply weekly use figure by 20), the seasonal use range represented by the study is from 1,600 to 18,800. This spans the range of actual use levels from 1966 (1,067 people) to 1972 (16,428 people).

River and Attraction Site Contacts

The effects of different use levels on contacts with other trips are shown in Tables 1-5. Use levels are categorized in three ways. The first is the number of people per week leaving Lee's Ferry. (For each trip, the week is taken as the departure day plus the three days preceeding and following.) Second, each weekly level can be associated with an approximate seasonal level by multiplying the midpoint of the range by 20 (the number of weeks in the current season). Finally, use levels (in terms of people per week) can be associated with the number of trips per week leaving during that period. The trip figure is easier to use from a management point of view. It provides essentially the same information as the people figure, since the two measures are highly correlated ($r = .94$). All three use figures are given in each Table.

The effects of average use during 1975 are shown in Table 1. Tables 2, 3, and 4 show the effects of low, medium, and high use levels which occurred during 1975. The effects of higher (projected) use levels are shown in Table 5. Tables 1-5 are summarized in Table 6.

A distinction is made between contacts which occur on the river and those occurring at attraction sites (campsite contacts will be discussed separately). The contact levels given in Tables 1-6 are average values which represent ranges. The size of these ranges can be estimated from the standard deviation figures given in Tables 1-4. For example, the overall average use level of 660 people per week leaving Lee's Ferry is associated with a river contact level of 3.4 encounters per day. The standard deviation for this contact level is 1.9. This means that the contact level associated with the 660 person use level generally (about two-thirds of the time) ranges from 1.5 to 5.3 contacts per day. These ranges are fairly large because only a small number of trips was sampled. In addition, the figures in these tables are based on current use patterns in terms of types and lengths of trips and schedules of departures. Changes in the situation (such as altering departure schedules) would certainly alter these values, perhaps in unpredictable ways.

Contacts during average use periods. The present average use level is 660 people per week (see Table 1). A typical trip during the 1975 season met between three and four other trips on the river each day and spent a total of 39 minutes per day in sight of them. The number of people on the trips encountered was about 70.

TABLE 1

EFFECTS OF USE LEVEL ON THE RIVER EXPERIENCE¹
CURRENT AVERAGE

660 PEOPLE (26 TRIPS) PER WEEK, 12,700 PEOPLE PER SEASON

RIVER CONTACTS ²			ATTRACTION SITE CONTACTS ²										
con- tacts in pre day	time in sight (min.)	people per day	% of sites (total) with contact	Probability of meeting another trip at:								Average number of people met at:	
				Little Colorado	Elves' Chasm	Deer Creek	Havasupai Creek	all four sites	Little Colorado	Elves' Chasm	Deer Creek	Havasupai Creek	all four sites
3.4 (±1.9)	39 (±33)	72 (±47)	46 (±22)	.63 (±.49)	.63 (±.49)	.67 (±.47)	.85 (±.36)	.70 (±.29)	36 (±45)	30 (±31)	27 (±26)	58 (±49)	37 (±24)

¹Figures are based on current use patterns, and might change if, for example, departure schedules were altered. There are 8, 16, and 22 cases in the low, medium, and high use categories, respectively.

²These are mean values which represent ranges. The range represented by the mean value plus and minus the standard deviation (number in parentheses) is the 68% confidence interval, indicating that 68% of the time this interval will include the mean.

TABLE 2

EFFECTS OF USE LEVEL ON THE RIVER EXPERIENCE

LOW DENSITY

80-400 PEOPLE (13 TRIPS) PER WEEK, 4,800 PEOPLE PER SEASON

RIVER CONTACTS			ATTRACTION SITE CONTACTS										
con- tacts per day	time in sight (min.)	people per day	Probability of meeting another trip at:							Average number of people met at:			
			% of sites (total) with contact	Little Colorado	Elves' Chasm	Deer Creek	Havas Creek	all four sites	Little Colorado	Elves' Chasm	Deer Creek	Havas Creek	all four sites
1.1	13	17	20	.50	0	.25	.63	.34	13	0	8	19	9
(±.8)	(±14)	(±15)	(±16)	(±.53)	(±0)	(±.46)	(±.52)	(±.27)	(±14)	(±0)	(±16)	(±14)	(±7)

TABLE 3

EFFECTS OF USE LEVEL ON THE RIVER EXPERIENCE

MEDIUM DENSITY

401-700 PEOPLE (24 TRIPS) PER WEEK, 11,000 PEOPLE PER SEASON

RIVER CONTACTS			ATTRACTION SITE CONTACTS										
con- tacts per day	time in sight (min.)	people per day	Probability of meeting another trip at: Average number of people met at:										
			% of sites (total) with contact	Little Colorado	Elves' Chasm	Deer Creek	Havas Creek	all four sites	Little Colorado	Elves' Chasm	Deer Creek	Havas Creek	all four sites
2.9 (±1.0)	37 (±23)	62 (±29)	47 (±20)	.63 (±.50)	.63 (±.50)	.63 (±.50)	.88 (±.34)	.69 (±.30)	37 (±41)	28 (±22)	32 (±30)	68 (±49)	40 (±13)

TABLE 4

EFFECTS OF USE LEVEL ON THE RIVER EXPERIENCE

HIGH DENSITY

701-950 PEOPLE (32 TRIPS) PER WEEK, 16,500 PEOPLE PER SEASON

RIVER CONTACTS				Attraction Site Contacts			
con- tacts per day	time in sight (min.)	people per day	% of sites (total) with contact	Probability of meeting another trip at:			
				Little Colorado	Elves' Chasm	Deer Creek	Havasupai Creek
4.7 (±1.7)	50 (±38)	100 (±45)	55 (±17)	.68 (±.48)	.86 (±.35)	.86 (±.35)	.91 (±.29)
				.83 (±.16)	.45 (±.53)	42 (±35)	31 (±25)
							all four sites
							all four sites

TABLE 5

EFFECTS OF USE LEVEL ON THE RIVER EXPERIENCE¹
PROJECTED USE LEVELS

USE LEVEL			RIVER			CONTACTS ²														
people per week	trips per week	people per season	contacts per day	time in sight (min.)	people per day	% of sites (total) with contact	Probability of meeting another trip at:						ATTRACTION SITES				Average number of people met at:			
							Little Colo.	Elves' Chasm	Deer Creek	Havasu Creek	all four sites	Little Colo.	Elves' Chasm	Deer Creek	Havasu Creek	all four sites	Little Colo.	Elves' Chasm	Deer Creek	Havasu Creek
1000	30	20,000	5.7	65	124	67	.84	1.0	.98	1.0	1.0	.99	55	54	39	87	60			
1250	47	25,000	7.2	83	159	81	.99	1.0	1.0	1.0	1.0	1.0	68	71	48	108	76			
1500	56	30,000	8.8	101	195	95	1.0	1.0	1.0	1.0	1.0	1.0	81	87	56	129	91			

¹Figures are based on current use patterns, and might change if, for example, departure schedules were altered.

²These are mean values which represent ranges. The sizes of the ranges have not been computed since these are projections. Projections assume the continuation of observed linear relationships.

TABLE 6

EFFECTS OF USE LEVELS ON THE RIVER EXPERIENCE*
SUMMARY TABLE

PROJECTED USE LEVELS																																	
CURRENT USE LEVELS																																	
USE LEVEL				RIVER				CONTACTS				ATTRACTION SITES																					
people per week		trips per week		people per season		contacts per day		time in sight (min.)		people per day		% of sites (total) with contact		Probability of meeting another trip at:				Average number of people met at:															
														Little Colo.		Elves' Chasm		Deer Creek		Havasupai Creek		all 4 sites		Little Colo.		Elves' Chasm		Deer Creek		Havasupai Creek		all 4 sites	
over-all	660	26	12700	3.4	39	72	46	.63	.63	.67	.85	.70	36	30	27	58	37																
low	80-400	13	4800	1.1	13	17	20	.50	0	.25	.63	.34	13	0	8	19	9																
med.	401-700	24	11000	2.9	37	62	47	.63	.63	.63	.88	.69	37	28	32	68	40																
high	701-950	32	16500	4.7	50	100	55	.68	.86	.86	.91	.83	45	42	31	63	46																
	1000	39	20000	5.7	65	124	67	.84	1.0	.98	1.0	.99	55	54	39	87	60																
	1250	47	25000	7.2	83	159	81	.99	1.0	1.0	1.0	1.0	68	71	48	108	76																
	1500	56	30000	8.9	101	195	95	1.0	1.0	1.0	1.0	1.0	81	87	56	129	91																

*These are average figures which represent ranges. They are based on current use patterns, and might change if, for example, departure schedules were altered. These are 8, 16, and 22 cases in the low, medium and high uses categories, respectively.

Encounters with other parties occur at about half (46%) of all the attraction sites visited. Specific probabilities of meeting others at the four most popular sites are also given in Table 1. There is about a 65% chance of contact at the Little Colorado River, Elves' Chasm, and Deer Creek Falls, and an 85% chance at Havasu Creek. The number of people encountered at these places is about 30 for the Little Colorado, Elves' Chasm, and Deer Creek, and 58 for Havasu. The probability of encounter and number of people figures can also be combined; for example, an average group has an 85% chance of meeting 58 people at Havasu.

Contacts during low use. The low density level shown in Table 2 is the closest thing to a "pure" wilderness experience which is currently available in the Canyon. The use level is 80-400 people or about 13 trips per week, which would result in a seasonal capacity of about 4,800 people. This approximates the actual use which occurred in 1968 (3,609).

River contacts during low density periods average one a day, with about 13 minutes spent in sight of 17 people. Contact occurs at 20% of all attraction sites. There is little chance of meeting anyone at Elves' Chasm, a 25% chance of meeting someone at Deer Creek, and a 50-60% chance of contact at the Little Colorado and Havasu. Average number of people encountered at these sites is close to zero for Elves' Chasm, about 8 for Deer Creek, and 15-20 for the Little Colorado and Havasu.

Contacts during medium use. Medium density during the 1975 season is represented by the 400-700 person use level, with about 24 trips leaving Lee's Ferry each week (see Table 3). This level of use, if sustained through the season, would produce an 11,000 person total use figure. This is close to actual use during 1971 (10,942).

On the river, contact is made each day with three other parties (about 60 people). Time in sight of others is 37 minutes. Contacts are made at almost half (47%) of all attraction sites. Probability of encounter at Little Colorado, Elves' Chasm, and Deer Creek is about 60%, and at Havasu it's 88%. Number of people met at these places is 30-35 for Little Colorado, Elves' Chasm, and Deer Creek, and almost 70 for Havasu.

Contacts during high use. High use levels during 1975 are represented by weeks in which 700-950 people (32 trips) left Lee's Ferry (see Table 4). This represents a seasonal use level of 16,500 people, close to the use which occurred in 1972 (16,428).

River contact at this level is 4.7 groups per day, with about 50 minutes in sight of other parties and about 100 people seen. Contact occurs at 55 percent of all attraction sites. Probability of encounter at the Little Colorado is .68. At Elves' Chasm, Deer Creek, and Havasu probabilities are close to .90. Numbers of people at these sites are 31 for Deer Creek, 40-45 for Little Colorado and Elves' Chasm, and 63 for Havasu.

Project higher use levels. Projected use levels are presented in Table 5. They provide some indication of the consequences of increased use in the Canyon. It should be pointed out that these values are based on extrapolations which go beyond current data. Such extrapolations assume that the linear relationships observed in the data collected apply as well to ranges beyond those data. Actual contact levels might be higher than projected if these use levels were instituted, but are not likely to be lower.

A use level of 1,000 people (39 trips) per week is associated with a 20,000 person season. This is what would result if the highest use weeks observed in 1975 were repeated throughout the season. We estimate that under these conditions river contacts per day would be 5.7, time in sight over an hour, and people met on the river close to 125. Encounters with other groups would occur at 67% of all sites, and the probability of encounter at the popular sites (Little Colorado, Elves' Chasm, Deer Creek, and Havasu) approaches certainty (84-100%). The average number of people met at each of these sites would be 40-55 for Little Colorado, Elves' Chasm, and Deer Creek, and 87 for Havasu.

It is possible to explore the effects of still higher use levels (1,250 and 1,500 people per week). River contacts would reach 7-9 per day, and time in sight would be about an hour and a half. Number of people seen on the river would be 160-200. Percent of sites with contact approaches 100, and encounters at the most popular spots are a sure thing. Number of people met at these places becomes high, on the order of 50-130.

Campsite Contacts

A separate campsite appears to be an important part of the outdoor experience; 90% of river runners in the Canyon preferred to camp out of sight and hearing of other trips. The current norm among boatmen is to avoid camping on the same beach as another party. In order to assess the current camp situation, observers recorded whether their group camped within sight or hearing of another.

Observers spent 444 nights on the river during the 1975 season. Of these, 40 (9%) were spent camped within sight or hearing of another party. Table 7 gives a breakdown of the proximity of the 40 camp encounters; 80% were within sight or hearing only, 15% were within sight and hearing, and only 2 (5%) were on the same beach. Both of these occurred at mile 87, the camp just above Phantom Ranch. The nature of and reaction to camp encounters are shown in Table 7. The other party was usually ignored (62% of the time), and reaction was generally neutral (54% of the time).

The distribution of camp contacts along the river is shown in Table 8. It can be seen that contacts tend to occur in certain areas. These correspond to the "bottle neck" areas identified in the campsite inventory (done for the Park Service by Yates Borden, et. al.). A third of camp contacts occurred in Marble Canyon, about 15% in the area above Phantom Ranch, 23% in the area around Deer Creek, and another 15% just below Havasu.

Data indicate that the rate of campsite contact does not increase at higher use levels. The average number of camp contacts per trip is .88 at the low use level, .75 at medium use, and .81 at high use. Within the current range of use, then, contact at campsites appears to be a function of location in the Canyon, not amount of use.

The preceding discussion tends to over-simplify the problem of crowding at camps; several factors combine to affect this situation. First, there are certain stretches of river where campsites are scarce. Second, there are certain areas (close to major attractions) where many parties try to camp. Finally, campsite contacts occur only when camps are within sight of one another (assuming parties do not camp on the same beach).

Congestion in terms of campsites is a function of supply (which is based on the number of camps in any given area) and demand (which is based on both use level and the desire to camp in certain areas).

TABLE 7

CHARACTERISTICS OF CAMPSITE CONTACTS

	<u>percent of total contacts</u>
Total camp contacts observed	100 (40)
Proximity to other party	
could see or hear	80 (32)
could see and hear	15 (6)
were right next to them	5 (2)
Nature of contact (own party)	
ignored	62 (24)
wave only	5 (2)
verbal greeting	5 (2)
chat	10 (4)
conversation	18 (7)
Reaction to contact	
negative	21 (8)
neutral	54 (21)
positive	26 (10)

TABLE 8

DISTRIBUTION OF COMP CONTACTS BY RIVER MILE

<u>Area</u>	<u>River Mile</u>	<u># of Contacts</u>	<u>Names of Landmarks</u>
Marble Canyon 33% (13)	0 - 10	1	
	11 - 20	2	North Canyon
	21 - 30	3	Shinumo Wash
	31 - 40	-	Buck Farm Canyon
	41 - 50	4	
	51 - 60	4	Little Colo. River
	61 - 70	1	
Above Phantom Ranch 13% (5)	71 - 80	3	all near Unkar (mi.72)
	81 - 90	2	at Phantom Ranch (mi.87)
	91 - 100	-	
	101 - 110	-	
8% (3)	111 - 120	3	near Elves' Chasm (mi.116)
	121 - 130	-	
23% (9)			Bedrock Rapid
	131 - 140	9	
			Deer Creek (mi.136)
			Fishtail Rapid
	141 - 150	-	
15% (6)	151 - 160	1	near Havasu (mi.157)
	161 - 170	6	all at National Canyon (mi.167)
	171 - 180	-	
	.		
	.		
	.		
	271 - 280	1	

Contacts require, in addition to congestion, that camps be within sight of one another. Camp contacts, then, are not always indicative of congestion. For example, there is a scarcity of camps in the 17 miles upstream from Havasu Creek. Demand for these camps is high, since most parties want to stop close enough above Havasu to be able to spend a large part of a day there. But there are few camp contacts in this area, since one camp can't be seen from another.

What this means is that contact data should not serve as the sole basis for understanding campsite congestion. Contact data need to be integrated with campsite inventory data (which indicate "supply") and use level and desirability data (which indicate "demand"). The latter data could be collected through the "intended schedule" procedure described later in this report. The camp congestion and contact situation could then be understood as a whole.

Adjustments for Crowding

The foregoing discussion indicates that level of use affects contact levels both on the river and at attraction sites, though not at campsites. The correlations of contact variables with use levels are summarized in Table 9. The next question is, do contacts affect the behavior of trips? Observers kept track of the number of times that boatmen passed up an intended side stop or changed their camping place because of the presence of other groups. They also recorded the number and length of stops at attraction sites. How does density affect these variables?

The correlations of these adjustment variables with density measures are shown in the first column of Table 10. It can be seen that adjustments for crowding are not significantly related to use levels as defined up to now in terms of departures from Lee's Ferry. However, the average number of river contacts per day gives a more accurate measure of downriver density, and the adjustment variables are correlated with this measure (middle column of Table 10). During periods of higher downriver density, boatmen made more changes in plans ($r = .47$), fewer stops at attraction sites ($r = -.42$), and apparently stopped for shorter periods at each site ($r = -.29$). However, all these variables are correlated with mode of travel (motor or oar), so the above relationships were re-calculated controlling for mode of propulsion. As shown in the last column of Table 10, the first two relationships obtain despite this statistical control, while the third does not.

TABLE 9

CORRELATIONS OF CONTACT VARIABLES WITH USE LEVEL

<u>VARIABLE</u>	<u>CORRELATION WITH USE LEVEL</u> <u>(PEOPLE PER WEEK)</u>
Trips per week	.94
River Encounters	
Contacts per day	.68
Time in sight (minutes)	.47
People per day	.65
Attraction Site Encounters	
Percent of sites (total) with contact	.58
Probability of meeting another trip at:	
Little Colorado River	.28*
Elves' Chasm	.69
Deer Creek	.43
Havasus Creek	.31*
All four sites	.58
Number of people met at:	
Little Colorado River	.25*
Elves' Chasm	.43
Deer Creek	.26*
Havasus Creek	.33*
All four sites	.51

*p < .05

all other probabilities are less than .01

TABLE 10

CORRELATIONS OF USE LEVELS WITH ADJUSTMENTS FOR CROWDING

<u>Variable</u>	<u>Correlation with:</u>		
	Use Level (Lee's Ferry)	Down river use level (river contacts per day)	Down river use level controlling for propulsion
Number of changes in plans per day	.23	.47*	.44*
Total number of sites visited	-.12	-.42*	-.30*
Average length of stops at sites	-.12	-.29*	-.13

*p < .05

The mean values for these adjustment behaviors at different levels of downriver density are shown in Table 11. At the current average level (3.4 contacts per day), trips make .38 changes in plans each day and visit about 14 attraction sites. At low levels of downriver density (less than 2 contacts per day), they make very few changes (.08 per day) and stop at 16 sites. At medium levels (2-5 contacts per day), adjustments increase to about one every other day (.43), but total number of sites visited drops only one to 15. At high levels of river encounters (5-10 contacts per day), adjustments are up to .60 and number of sites visited is down to 10.

At higher (projected) contact levels (10-12 contacts per day), changes in plans increase to more than one each day and number of sites visited continues to decrease (to 6 or fewer). These extrapolations are probably unrealistic. While the "changes in plans" variable might increase as projected, it seems likely that boatmen would continue to stop at the most popular sites rather than pass them up. Thus, a sharp decline in number of sites visited seems less likely than increased congestion at the better-known attractions.

PERCEIVED CROWDING

There is no absolute level of density or rate of contact which makes a given situation "crowded." Crowding is a social-psychological phenomenon, and the effects of density are mediated by such other situational variables as definition of the activity, crowding norms associated with that activity, social and physical aspects of the situation, and individual personality traits.

The contrast between a football game and a wilderness experience provides an interesting example. If only 500 spectators were seated in a large stadium for a football game, the density of people would be perceived as inappropriately small. As a result, the experience might be less enjoyable for many persons. In a comparable amount of space in the Grand Canyon, however, the same density of people would be seen quite differently. Here, 500 people in an area of several acres would be perceived as an overcrowded situation, having a detrimental effect on the experience. The difference, of course, is in the definition of the activity and norms about the "right" number of people for that activity. What we need to do, then, is 1) find out how people define the Canyon in terms of "wilderness" and "crowding," and 2) explore the relationship between density levels and perception of crowding.

TABLE 11

ADJUSTMENTS FOR CROWDING AND DOWNRIVER DENSITY¹

<u>Downriver Density (river contacts per day)</u>		<u>Adjustments for Crowding²</u>	
		number of changes in plans per day	total number of sites visited
Current Levels	Overall 3.4	.38 (±.43)	14 (±6)
	Low 0 - 2.0	.08 (±.12)	16 (±5)
	Medium 2.1- 4.9	.43 (±.30)	15 (±6)
	High 5.0- 9.5	.60 (±.53)	10 (±4)
Projected Levels ³	10	1.06	6
	11	1.17	4.7
	12	1.27	3.5

¹Figures are based on current use patterns and might change if, for example, departure schedules were altered. There are 11, 25, and 10 cases in the low, medium, and high contact categories, respectively.

²These are mean values which represent ranges. The range represented by the mean value plus and minus the standard deviation (number in parentheses) is the 68% confidence interval, indicating that 68% of the time this interval will include the mean.

³The sizes of the range have not been computed since there are projections. Projections assume the continuation of observed linear relationships.

TABLE 12
EFFECT OF DENSITY ON PERCEIVED CROWDING

<u>Variable</u>	<u>Correlation with per- ception of crowding¹</u>	<u>Correlation with per- ceived impact use</u>
People per week leaving Lee's Ferry	.05	- .06
River contacts per day	.05	- .08
People per day seen on river	.05	- .06
Time in sight of people on river	.03	- .05
Percent of attraction sites (total) with contact	.12*	.01
Average number of people seen at attraction sites	.13*	- .03

*p < .01

¹Perceptions of crowding and use impact are measured with scales which combine selected items in Tables 11 and 12. Scale construction is discussed in Part I of this report.

The River Trip as a Wilderness Experience

The vast majority of river travelers define their trip as a wilderness experience. As shown in Table A1 (found in Appendix 1), 91% agreed that they would consider the area a "wilderness." Most people (65%) prefer two or less river contacts per day, and 90% prefer to camp away from others. Small travel groups are considered most appropriate, with 57% preferring groups of 20 or less and another 29% favoring groups of 20-30 persons.

In addition, people generally view the Canyon as a place where developments and conveniences are out of place. Only 10% felt there should be more developments like Phantom Ranch, and only 7% favored building a tram into the Canyon (see Table A2). A similarly small number favored more conveniences (9%) and better facilities (12%) on river trips.

Crowding in the Canyon

Most people perceive the Canyon as relatively uncrowded. As Table A3 shows, 69% did not think they met too many people during their trip. By contrast, about 30% felt there were too many people on the river or at side stops. Campsite contacts were no problem for most; only 7% indicated that too often they had to camp near others.

Along the same line, most river travelers perceive little impact of use in the Canyon. Seventy-eight percent felt the Canyon was relatively unaffected by man's presence, and 75% felt it was not being damaged by over-use (see Table A4). A minority (10-30%) felt there was damage due to litter, trampling of vegetation, and over-use of camps and attraction sites.

Contacts and Perceived Crowding

In general, then, 90% of river runners see the Canyon as a wilderness where further development is inappropriate, and 70% see it as uncrowded and unaffected by use. How are these perceptions of crowding affected by different levels of use? Table 12 shows that perception of crowding is unrelated to overall use level ($r = .05$). It is also unrelated to river contact level in terms of contacts per day ($r = .05$), number of people seen each day ($r = .05$), or time in sight of other parties ($r = .03$). There is a statistically significant ($p < .01$) relationship between perceived crowding and level of encounter at attraction sites, in terms of percent of sites (total) with contact ($r = .12$) and average

number of people seen ($r = .13$). However, neither of these relationships is large enough to be of much substantive importance. The right hand column in Table 12 indicates that these density variables are also unrelated to perceived impact of use. In sum, 30% of the people who travel the river think the Canyon is crowded, but this has little relationship to the number of people they actually saw.

EVALUATION OF THE EXPERIENCE

It has generally been assumed that crowding in wilderness affects overall satisfaction with the experience. In previous studies, satisfaction has generally been measured by asking some form of the question, "Did you have a good time?" In order to compare the present study to others and to test the crowding model, we asked river passengers, "Overall, how would you rate your trip?" Out of 984 responses, only 1% rated their trip as "fair," 4% as "good," and 11% as "very good." Fifty-five percent said "excellent, only minor problems," and 29% said, "perfect." For what it's worth, Colorado River runners certainly had a good time.

The relationship of satisfaction to the crowding variables is shown in Table 13. There is a statistically significant relationship to perception of crowding ($r = -.14$, $p < .01$); those who perceived the Canyon as more crowded rated their trip lower. Again, however, the relationship is too small to be of much importance. Trip rating is also unrelated to any of the other density and contact measures discussed earlier. In other words, people are having a good time on river trips. This has nothing to do with use level or number of contacts, and little to do with whether they perceive the Canyon as crowded.

TABLE 13
CROWDING AND SATISFACTION

<u>Variable</u>	<u>Correlation with over- all trip rating</u>
Perceived crowding	- .14*
People per week leaving Lee's Ferry	.00
River contacts per day	.05
People per day seen on river	.03
Time in sight of people on river	.10*
Percent of attraction sites (total) with contact	- .01
Average number of people seen at attraction sites	.02

*p < .01

WHY THE CROWDING MODEL DOESN'T WORK

The model presented at the outset suggests that use levels affect contact rates, contact rates affect perception of crowding, and perceived crowding affects satisfaction. Data presented here indicate that only the use level-contacts relationship holds among Grand Canyon River runners. Perception of crowding is independent of contact rates, and satisfaction has little to do with either contacts or perceived crowding. Why is this the case?

"Crowding" is a social-psychological phenomenon. Actual density is an important variable, but the definition of a given activity and the crowding norms associated with it appear to play a greater part in defining a situation as "crowded." Having hundreds of people within 20 or 30 yards is about right at a football game, but too crowded in the wilderness. The norms about crowding in a stadium are fairly explicit and widely shared, but what about wilderness, river trips, and the Grand Canyon? Our data show that 90% of river runners are making their first trip through the Canyon, and 49% had been on no other river trips of any kind. Most river runners would thus be unlikely to have a pre-established norm upon which to base their evaluations, either of crowding or the overall experience.

River passengers were asked about their expectations regarding encounters with other groups. Responses are given in Table 14. When asked specifically how many groups they expected to see each day on the river, 53% indicated that they didn't know what to expect. In response to a more general question comparing their expectations to the number of people they actually saw, 34% said they didn't know what to expect. In addition, response to the specific expectation item indicate that there is little agreement among those who did have specific expectations.

VARIABLES RELATED TO PERCEPTION OF CROWDING

River trips are fairly unusual among outdoor activities, and the Grand Canyon is unique among river trips. It should come as no surprise that many river runners have no pre-existing norm about encounters and that there is little agreement among those with norms.

TABLE 14

EXPECTATIONS REGARDING CONTACTS

How many parties per day did you expect to see while floating on the river?

<u>Response:</u>									Didn't Know What
None	1	2	3	4	5	6 to 10	11 to 20		What to Expect
Percent in each category (n=942):									
10	6	11	7	4	4	4	1		53

Overall, how many people did you expect to see during the trip?

<u>Response:</u>	<u>percent in each category (n=966)</u>
1. Less than you actually saw	25
2. About as many as you actually saw	27
3. More than you actually saw	11
4. Didn't know what to expect	34

This lack of consensus, is the most plausible explanation for the lack of an overall relationship between perceived crowding and actual experiences of contact. If river runners' perceptions of crowding are not related to contact level, are there other variables measured in our study that can help us to interpret these perceptions?

Past Experience

It has been suggested (White, 1971) that people tend to want particular environments to remain at the development or density level existing at the time of their first exposure to that environment. In White's words, "Each wants his particular town and country landscape to remain just as it was when he or she arrived. The most recent settler wants to be the last settler." White was referring specifically to residence environments. The same notion can be applied to wilderness perception.³ If a person's perception of wilderness (i.e., what he thinks it should be) is determined in this way, those with more experience should be more sensitive to crowding.

Information presented in the top part of Table 15 gives little support to the last settler hypothesis. Those with past outdoor experience are not much more likely to perceive the Canyon as crowded, whether "experience" is defined as general outdoor activity ($r = .10$), experience on other rivers ($r = .14$), or experience in the Grand Canyon ($r = .04$). Perception of crowding is also unrelated to membership in an outdoor club or organization ($r = .15$) or the time of first wilderness experience ($r = .13$).

Ideology Regarding Wilderness

Travel modes. Perceived crowding is related to a number of variables that express personal ideologies about wilderness (see Table 15). The first group of these has to do with different travel modes. People who felt the Canyon was crowded found motors and their noise inappropriate. They were more likely to say they were bothered by motor noise ($n=.32$) and that they felt banning motor travel would make the Canyon more of a wilderness ($r = .47$). They also expressed a preference for oar travel ($r = .31$), small groups ($r = .29$), and private parties ($r = .22$). Perceived crowding is also related to trip type; those on motor trips were less likely to say the Canyon was crowded ($r = -.23$). Because trip type is correlated with the above variables, its effect on their correlations with perception of crowding was removed through statistical control. The adjusted correlations in the right hand column of Table 15 show that the relationships are still significant and in the same direction, although their magnitudes are different.

TABLE 15

VARIABLES RELATED TO PERCEIVED CROWDING		
Variable	Correlation with Perceived Crowding	Correlation With Perceived Crowding Controlling for Propulsion
Past Experience		
Outdoor activities	.10	.05 ¹
On other rivers	.14	.08
In Grand Canyon	.04 ¹	.02 ¹
Club membership	.15	.09
Time of first wilderness experience	.13	.10
Ideology Regarding Wilderness		
Travel Modes		
Outboard motor noise is bothersome	.32	.23
Canyon more of a wilderness if motors banned	.47	.42
Prefer to run with oar trip	.31	.21
Prefer to run with small trip	.29	.25
Prefer to run with private trip	.22	.17
Own trip type (coded 1=oar, 2=motor)	- .23	-
Encounter Expectations and Preferences		
Number of encounters expected (specific)	- .30	- .19
Number of encounters expected (general)	- .39	- .41
Preferred number of encounters	- .40	- .37
Willingness to "pay a price" for solitude		
General	.34	.32
Missing stops at sites	.22	.21
Hike further at sites	.42	.39
The Canyon as Wilderness		
Would consider the Canyon a "Wilderness"	- .26	- .26
Use impact perceived as high	.64	.61

¹NS. All other probabilities are less than .01.

Encounter expectations and preferences. Those who saw the Canyon as crowded differed in their feelings about meeting other groups. They said they expected fewer encounters in response to both general ($r = -.30$) and specific ($r = -.39$) questions. They also indicated a preference for fewer encounters ($r = -.40$).

Willingness to "pay" for solitude. Those who were bothered by crowding were more prepared to do something about it. They indicated a greater willingness to "pay a price" (in terms of money, waiting longer to go on the trip, or putting up with less convenient schedules) in order to achieve their preferred contact level ($r = .34$). They were also more willing to miss one site in exchange for solitude at another ($r = .22$) or hike further to avoid other groups ($r = .42$).

The Canyon as wilderness. Finally, those who saw crowding as a problem perceived the Canyon differently. They were less likely to say they would consider it a "wilderness" ($r = -.26$), and more likely to perceive it as heavily affected by human use ($r = .64$).

In summary, perceived crowding in the Canyon is not related to past outdoor experience, a finding which discredits the "last settler" notion. It is related to a number of ideological variables having to do with wilderness, including appropriateness of certain travel modes, encounter preferences and expectations, "willingness to pay" for solitude, and perception of human impact on the Canyon.

VARIABLES RELATED TO USER SATISFACTION

Satisfaction is essentially unrelated to either perceived crowding or actual level of contact. Aside from the crowding issue, however, what factors are associated with user satisfaction in the Canyon? Answers to the trip rating question were related to responses in other topics such as personal benefits gained from trips, social aspects of the experience, and wilderness perception (see Table 16).

TABLE 16
VARIABLES RELATED TO USER SATISFACTION

<u>Variable</u>	<u>Correlation With Trip Rating*</u>
Personal Benefits	
Subjective Learning	.31
Personal Growth	.19
Social Aspects	
Quality of Group Experience (subjective)	.32
Accessability of Boatmen	.32
Rating of Boatmen	.37
Passenger Role was Unambiguous	.28
Wilderness Character of the Experience	
Being in wilderness an important reason for trip	.20
Pace of trip perceived as leisurely	.29
Evaluation of trip as a "nature experience"	.31
Trip perceived as "noisy"	- .24
Use impact perceived as high	- .20
Would prefer more conveniences	- .29
Other	
Weather perceived as bad	- .22
Was unprepared for trip	- .22

*p < .01

Personal Benefits

The first group of variables is related to personal benefits derived from the trip. Those who felt they learned a great deal about geology, rivers, ecology, and nature in general rated their trip higher ($r = .31$), as did those who experienced personal growth ($r = .19$).

Social Aspects

Social aspects of the trip also contributed to satisfaction. Those who rated the social quality of their group experience higher were more satisfied ($r = .32$). Those who felt the boatmen were friendly and interesting ($r = .37$) and accessible for questions ($r = .32$) also rated the trip higher. A clear understanding of the passenger role was also a positive factor ($r = .28$).

Wilderness Character of the Experience

Correlations of a number of variables with trip rating indicate that the wilderness character of the experience is important. Those for whom "being in the wilderness" was a primary reason for taking the trip were more satisfied ($r = .20$), as were those who perceived the pace of their trip as leisurely ($r = .29$) and those who felt it was a "nature experience" ($r = .31$). Perception of the trip as noisy ($r = -.24$) or use impact as high ($r = -.20$) detracted from satisfaction, and those who would have preferred more conveniences and facilities ($r = -.29$) were also less happy with the trip.

Other Factors

Two other factors deserve brief mention. Those who perceived the weather as bad were less satisfied ($r = -.22$), as were those who reported that they were unprepared for the trip ($r = -.22$).

SUMMARY

Perceived crowding is unrelated to contacts, and satisfaction is not affected by perception of crowding. Generally, this can be explained by 1) the preponderance of first-time users in the Canyon, and 2) the lack of shared normative expectations about the experience. Perception of crowding is unrelated to prior outdoor experience, but it is related to a number of wilderness-related ideological variables,

including ideas about travel modes, encounters with other groups, willingness to "pay" for solitude, and the Canyon as wilderness. Satisfaction, in turn, is related to a number of variables, including personal benefits, social aspects of the trip, and the wilderness character of the experience.

IMPLICATIONS FOR MANAGEMENT

THE "SATISFACTION" MODEL

A great deal of research has been based on the satisfaction model, with the apparent presumption that satisfaction can be "managed." While data presented here indicate that satisfaction is of little value as a management criterion, the idea of maximizing satisfaction has much intuitive appeal. A brief discussion of the satisfaction model may be helpful in further specifying the problems inherent in this approach.

There are two major explanations for the lack of relationship between crowding (perceived or actual) and satisfaction. The first, discussed earlier, is that first time visitors have little with which to compare their experience. Thus, they have no basis for comparison in evaluating crowding on their trip.

The second explanation is that the crowding model itself has a number of shortcomings. First among these is that the connection between crowding and "satisfaction" has been greatly over simplified. Heberlein (n.d.) presents a model (Figure A1 in Appendix 1) that identifies twelve sets of variables potentially affecting user satisfaction. Included are type of activity, substitutable activities, costs of obtaining alternative experiences, the character of the recreational activity, quality of intra-group experience, weather and resource condition, prior experience, and personality characteristics. These are in addition to specific crowding variables such as density preference, density expectation, actual density, and perceived density. If all these affect satisfaction, it should come as no surprise that two variables (actual encounters and perceived crowding) show little or no effect in the results presented here.

The second shortcoming of the crowding model is based on the fact that recreation behaviors are largely voluntary and therefore self-selected. As a result, users choose activities which are in accord with their normative idea of a "good time." They will probably show high satisfaction levels, as they do in the Grand Canyon whatever the activity happens to be.

The third problem, again because recreation activities are self-selected and voluntary, is that those dissatisfied with crowding may move on to less crowded areas, thus being "displaced" by those with norms more tolerant of higher densities. Crowding norms, then, change due to alterations in group composition. The result is that aggregate satisfaction continues to climb with increasing use; "carrying capacity" (the point at which satisfaction declines) is probably never reached.

Finally, increasing densities may cause a change in the definition of the experience. Increased use alters the character of the experience from, for example, zero-contact wilderness to moderate contact semi-wilderness. As this happens, people probably change their normative definition of appropriate contact levels. Changes in the experience, then, cause individual normative changes, and satisfaction remains high. This subtle "product shift" would again mean that satisfaction continues to climb as use increases.⁴

Two additional factors deserve brief mention. First, the Grand Canyon is an incredible place, and the experience of being in it a week or two is, for most people, simply overwhelming. Most of their "good time," then, could be accounted for by the resource itself. Second, people completing a river trip have just made a sizable investment of effort, money and probably vacation time. They chose the trip, and of course, they enjoyed themselves! Social psychological research suggests that this high investment situation would lead to a positive evaluation of the experience.

An example illustrates these points and shows some possible implications of a management strategy aimed at maximizing satisfaction. A Grand Canyon Parkway along the Colorado River would certainly increase the number of satisfied Canyon visitors. Dissatisfied seekers of wilderness and solitude might go elsewhere, the influx of people more tolerant of crowding would cause contact norms to change, and the new "product" (the Grand Canyon by automobile) would be defined in terms of higher contact rates. The Canyon would still be an incredible place, and people visiting it would still have a fine time.

The reason that a parkway sounds so out of place is that it would dramatically change the character of the "Grand Canyon experience." People think of the Canyon in terms of undeveloped wild country and the wilderness experience (as data presented earlier indicate), and a highway is antithetical to those values. The satisfaction model is beguiling in its apparent "objectivity," but it is based on the assumption (or value) that aggregate satisfaction should be maximized. When we see that maximizing satisfaction may lead to a Grand Canyon Parkway, the existence of the value judgment becomes more obvious.

Likewise, biological studies can establish carrying capacities on the basis of a value premise. For example, a carrying capacity for predators can be established under management objectives which value a diversified ecosystem, with no species eliminating another. With different values, such as "no lambs or calves ought to be eaten by wolves," a different carrying capacity will be selected. It appears that expert judgment can establish biological or physical capacity, but this is so only because on these matters the value premise is more likely to be shared than it is for sociological carrying capacity (where there are many competing interests).

Any carrying capacity, then, is based on values. This is why the political process, in some fashion, must always be involved. Sociological research can best serve resource managers by specifying as clearly as possible the consequences (in terms of the character of the experience) of different management alternatives. It is then possible to manage for the experience (and corresponding use level) which best fits the values in question.

CHOOSING AN APPROPRIATE USE LEVEL

In order to control the crowding situation in the Canyon it is necessary to decide what things can effectively be managed. The density of trips in the Canyon is regulated at Lee's Ferry; it is thus possible to manage the size, number, length, and kind of trips which depart during a given time period. Data presented earlier indicate that these variables do affect the character of the experience (contacts among parties), both on the river and at attraction sites. They do not, however, affect trip satisfaction, either directly or indirectly. Because of this, it is reasonable to manage for the character of the experience. It does not seem reasonable to attempt to manage for satisfaction.

None of the data presented here indicate what level of use should exist in the Canyon. Rather, they specify (within certain ranges) the effects of different management alternatives on the character of the experience. In choosing a use level, it is necessary to consider the implications in terms of 1) river contacts, 2) attraction site contacts, and 3) adjustments for crowding. The river and site contact levels associated with different use levels are summarized in Table 6. The adjustment levels for each contact level are found in Table 11. It should again be emphasized that the average values in these tables are subject to sizable variation from one trip to another. An indication of this variation can be obtained from the range values presented in Tables 1-5.

Choosing one use level or another requires that managers first specify or define the kind of experience to be provided, and then choose a contact level which is appropriate for that kind of experience. These issues suggest difficult questions about what "ought" to be in the Grand Canyon. Answers need not be arbitrary; they can be formulated on the basis of information from several sources, including user preferences (reported in this study), public input (from the public involvement process), the legal mandates and ethical standards of the National Park Service, and managerial expertise. Managers, in addition to contributing their knowledge, have the task of integrating inputs from the different sources and formulating policy alternatives.

The alternatives for "definition of the experience" in this case seem to be 1) solitude, 2) the more usual wilderness experience, or 3) some higher density experience, such as an "excursion." Solitude, or a "pure" wilderness experience, means seeing no one else. This is most closely approximated in the Canyon by the low density option discussed earlier (Table 2), and it would require a substantial reduction in current river travel.

The more usual wilderness experience is a second alternative. It can be defined in terms of the situation encountered in many parks and wilderness areas throughout the West. While the object of this experience may be minimal contact with others, a few encounters do no appear to represent an unreasonable impingement on solitude.

The excursion is a third alternative. The object of an excursion is to "see the place" rather than to experience solitude in wild country. An example might be the bus ride on West Rim Drive; neither the number of people on the bus nor the number of other buses greatly affects the experience.

User preferences and perceptions reported in this study indicate that most river passengers define the river and their experience in terms of wilderness. People prefer small travel groups, low numbers of contacts, campsite privacy, and little or no development. Most of the inner Canyon, with the exception of the river, is currently designated and managed as wilderness. Choosing to provide a "wilderness experience" thus seems to be the alternative most consistent with the current character of the experience.

Determining the appropriate use level for the Canyon is more difficult. Most people report having a good time in the Canyon. If there were a "Grand Canyon Parkway" along the river and an amusement park at Phantom Ranch, the new user groups interested in these facilities would probably also report high levels of satisfaction. It is necessary, then, to establish a level of contact or crowding which is acceptable for the Canyon. At what point does a wilderness experience become an excursion? Ultimately, the selection of a number has an arbitrary aspect, as in deciding that three contacts per day are acceptable but four are not. Such problems are inherent in the setting of limits, but our data do show a substantial effect of manageable use level variables on the river experience. Use of this information along with public involvement can make selection of a management goal much less arbitrary.

An example of how the public could be involved is helpful in understanding this point. Participants in a recent Park Service Intake Training Course at the Albright Training Center were asked about the maximum amount of contact with other visitors they personally would tolerate before their trip down the Canyon would "no longer be a wilderness experience."⁵ Ratings were made for river, camp, and attraction site encounters; results are given in Table A5.

Consideration of the responses suggests several interesting points. First, norms differ even among management professionals familiar with crowding problems. It is not surprising that our results among passengers show little normative consensus. Second, the specific norm about which there exists the most agreement is that wilderness means zero contact. For both river and attraction site contacts, about 30% felt that any contact at all would destroy their wilderness experience; at camps, 64% felt there should be no contact. Third, there is agreement that contact levels should be low, even though there is disagreement on actual numbers. About 75% feel that river contacts per day should be three or less, probability of meeting 30-50 others at major attraction sites should be less than 20%, and that camp encounters should occur no more often than one night in ten.

Most importantly, however, this information suggests a method for establishing norms about encounters in the Canyon. This kind of data collection could be part of the public involvement process, with responses classified according to different interest groups (Sierra Club, outfitters, etc.) so managers will know the position of each group (see Heberlein, 1975, for further discussion of the public involvement process). Table A5 (with percentages deleted) provides a possible format for obtaining questionnaire responses.

USE CONCENTRATIONS AND SCHEDULING

Concentration of Use

It is important to understand that most management problems related to crowding result from the "concentration" of use; that is, use is not evenly distributed, but tends to be concentrated in certain areas and at certain times. The discussion presented in this report indicates that crowding occurs mainly in a few specific areas. While attraction sites and camps are places where people are more sensitive to crowding, the "problems" in the Canyon are concentrated in certain sections of the river (in the case of camps) and at the most popular attraction sites. Such problems can be alleviated by decreasing overall use, but they could also be diminished by scheduling designed to disperse down river use.

Scheduling Stops and Camps

Scheduling involves two kinds of "crowding," actual and psychological. The first is the result of encounters with other groups, while the second results from the pressure of a schedule and the knowledge that another party is moving in as one's own moves out. Scheduling is an attempt to reduce actual crowding without producing too much psychological crowding. It might be particularly effective for commercial use in the Canyon, since passengers need not (and generally do not) know the schedule a boatmen is following.

For example, it would be possible to schedule camps in the "bottle neck" areas in the Canyon. The scheduling requirements need not be oppressive, perhaps along the lines of "if you're planning to camp in the 20 miles above Havasu, you need to specify in advance the date and your camp." Boatmen would know they had a site in the congested area, and camping above or below could be done on the current informal basis. More complete reservation systems are already in effect on other rivers (e.g., the Middle Fork of the Salmon).

A schedule could list all camps in bottle neck areas. The ranger checking out trips at Lee's Ferry would ask trip leaders where they planned to camp and record this information. Coupled with the use level data already available, this would give valuable information about the physical capacity of camps in certain areas of the Canyon.

Stops at the five or six most popular sites (Redwell Cavern, the Little Colorado River, Elves' Chasm, Deer Creek, and Havasu) could also be scheduled. For example, a group might reserve a morning or afternoon period at Havasu. If they wanted to spend the whole day, they would hike a certain distance upstream to avoid extensive contact with those on shorter stops.

Scheduling at these sites could be done in a manner similar to that described above. As a preliminary to actually scheduling camps and stops, it would make sense to devise a scheduling form and collect data on the intended camps and stops (in the high use areas) of river parties. It would be understood by all that the schedule did not require adherence. Such a procedure would have several benefits. First, boatmen would become aware of use concentrations and strategies for dealing with them. They would also "get used to" the idea of scheduling, making its implementation easier if it were later deemed desirable. Second, constructing and administering the schedule would provide a "dry run," making it possible to discover problems before trip schedules become real commitments. Managers, too, could thus "get used to" scheduling. Finally, it would be possible to see how "full" the high use areas are at different use levels. This would provide valuable data on capacities of these areas.

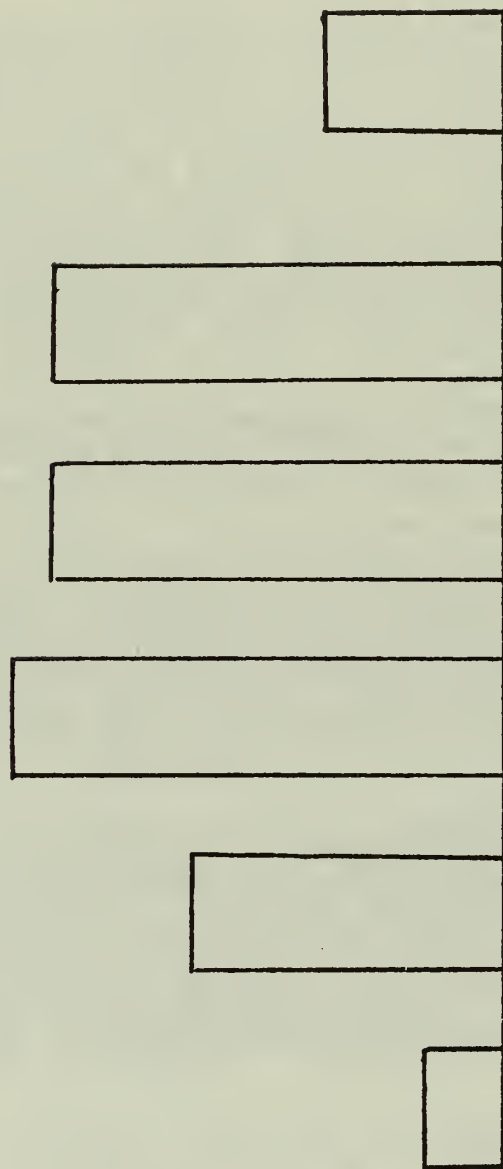
It should be pointed out that the idea of a schedule is not to provide one more regulatory hurdle for river travelers. Ideally, it would help people "co-exist" in the Canyon without getting in one another's way, in the cooperative spirit which marks the current river running scene. It is obvious, however, that a schedule can easily become "you must do this and can't do that." Care should be taken to avoid this situation in the Canyon.

To summarize, current use problems in the Canyon are concentrated in a few specific areas. Scheduling would probably help alleviate these problems while maximizing total use. If scheduling were used, it could be kept to a minimum, affecting only problem areas. Scheduling all stops and camps would probably be unnecessary and oppressive. A "practice" period, where schedules did not require adherence, would be helpful in introducing scheduling. More formal schedules might even prove unnecessary.

Dispersing Use Throughout the Season

Use is concentrated in time as well as space. Currently, most use occurs in May, June, July, and August (see Table 17). Total use could be increased without greater crowding if more use occurred in off-season months like April, September, or October,

TABLE 17
USE BY MONTH OF SEASON*



MONTH	April	May	June	July	August	September	Total
people leaving Lee's Ferry	487	2,193	3,398	3,104	3,127	1,277	13,586
per cent of total use	4	16	25	23	23	9	100

* April through September only.

although consideration should be given to the ecological impacts of such use. In addition, use is concentrated on certain days of the week (see Table 18). Given a set of "acceptable" contact levels associated with a specific daily departure figure, distributing use evenly throughout the week would maximize total use. It might also even out downriver congestion.

Discussion of these kinds of changes in departure schedules points up shortcomings in the current "user-day" allocation system. While user-days provide a convenient means of dividing the total "user-pie" among different outfitters and user groups, they are difficult to relate to the character of the river experience. A figure like 89,000 user-days per season gives little indication of downriver density, and could produce more or less river contacts than 100,000 user-days, depending on the distribution of use. Smaller time units are needed. The data presented in this report make it possible to choose a contact level, which can then be associated with a weekly use level. This level would be divided by seven to give a daily departure limit.

The figure used (people or trips per day) makes little difference, since either gives essentially the same information (they are highly correlated, $r = .94$). The trip figure would be easier for managers to use, since it requires no estimate of trip size from outfitters and would be easier to add up to determine total requests. The primary purpose of a limit is to insure that acceptable ranges of contact are not exceeded. Although group size has some effect on contacts, trips are the more obvious units of contact. A secondary function of a limit is to keep launch confusion at Lee's Ferry to a minimum. Confusion, like contact, is probably more related to number of trips than number of people.

At any rate, variation in numbers of people should not be large, since trip size has an upper limit (currently 40 persons). In fact, there is only a rough correspondence between current departure predictions (which are in terms of people) and actual departures. Greater precision seems unnecessary.

Even with new limits, use will probably have "peak" periods during certain months of the seasons and days of the week. Limits simply set the size of the peaks, without necessarily affecting the evenness of use distribution. If it is desirable to maximize total use, it might make sense to offer incentives for use during non-peak periods. Either outfitters or different user groups might be allowed to run trips (within some limit) which did not count toward their allotments.

TABLE 18

USE BY DAY OF WEEK*

Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total
Average number of people leaving Lee's Ferry	78	132	139	31	33	34	98	545
per cent of weekly use	14	24	26	6	6	6	18	100

* April through September only

River Runners' Willingness to Alter Their Trips

River runners were asked about their willingness to alter their trip in order to minimize contact with other groups. Responses for commercial passengers and private runners are given in Table 19. In order to achieve their preferred river contact level, a sizable minority were willing to: pay \$100 more (32%), wait a year to go on the trip (37%), follow a more strict trip schedule (39%), take the trip in the off-season (28%), or have less flexible trip departure dates (48%). Thirty percent were unwilling to do any of these.

People were also asked about strategies to minimize contact at attraction sites. Few (9-14%) were willing to miss stopping at one site (e.g., the Little Colorado River or Havasu), even if they were assured of solitude at the other. A larger percentage (44%) were willing to hike further at these places in order to avoid seeing other groups.

Commercial boatmen responded to a similar set of items (see Table 20). In order to achieve their preferred river contact level, 18% were willing to follow a more strict schedule. A larger proportion were willing to take more trips in the off-season (63%) or to have less flexible departure schedules (47%). Twenty-two percent were unwilling to do any of these.

For attraction site contacts, only 10-21% were willing to miss one major site in order to have little or no contact at another. However, 70% were willing to hike further to avoid contact at these places.

In sum, use is currently concentrated during certain months of the season and days of the week. More uniform distribution would maximize total use as well as even out downriver congestion. It makes sense to use "user-days" to allocate portions of the "user-pie." But to insure acceptable contact levels, weekly and daily launch limits are needed. Trips (rather than people) per day would be the easiest units to manage. Within these limits, "peak" use periods will probably still occur; incentives would help increase use during slower periods. River travelers show some willingness to alter their trips in order to minimize contact with other groups.

TABLE 19

WILLINGNESS TO ALTER TRIP TO MINIMIZE CONTACT
(Commercial Passengers and Private Runners)

Would you be willing to do any of the following things to get this (river contact) preference?

<u>Item</u>	<u>Percent Responding "Yes"</u>
Pay \$100 more.	32 (297)
Wait a year longer to go on the trip.	37 (347)
Follow a more strict schedule (of campsites, stops, etc.) during the trip.	39 (368)
Take the trip in April or October.	28 (262)
Have less flexible schedules of trip departure dates.	48 (439)
None of the above.	30 (278)

Your trip probably stopped at the Little Colorado River and Havasu Creek, and you probably saw other parties at both places.

<u>Item</u>	<u>Percent Responding "Yes"</u>
Would you be willing to miss stopping at one of these places if you were assured of seeing no one at the other?	14 (138)
Would you be willing to miss stopping at one of these places if you saw only half as many people at the other?	9 (90)
Would you be willing to hike further at these places to avoid seeing other people?	44 (419)

TABLE 20

WILLINGNESS TO ALTER TRIP TO MINIMIZE CONTACT
(Commercial Boatmen)

Would you be willing to do any of the following things to get this (river contact) preference?

<u>Item</u>	<u>Percent Responding "Yes"</u>
Follow a more strict schedule (of camp-sites, stops, etc.) during the trip.	18 (23)
Take more trips in April or October.	63 (81)
Have less flexible schedules of trip departure dates.	47 (58)
None of the above	22 (28)

Your trip probably stopped at the Little Colorado River and Havasu Creek, and you probably saw other parties at both places.

<u>Item</u>	<u>Percent Responding "Yes"</u>
Would you be willing to miss stopping at one of these places if you were assured of seeing no one at the other?	21 (27)
Would you be willing to miss stopping at one of these places if you saw only half as many people at the other?	10 (13)
Would you be willing to hike further at these places to avoid seeing other people?	70 (89)

LEARNING THE CONSEQUENCES OF DIFFERENT MANAGEMENT ALTERNATIVES

As a final point, it should again be emphasized that data presented here are based on current distributions of use, both in time and space and also in terms of travel modes (motor or oar). Changing any of these factors through scheduling or re-distribution or motor and oar trips would certainly alter both encounter rates and crowding problems, in ways not completely predictable.

Try It and See

Two possibilities exist for learning about these effects. One is the "try it and see" approach, with "trying" requiring time and "seeing" requiring research funds. The "intended schedule" strategy outlined earlier is an example of this approach which has little risk, low cost, and high potential gain. These data could be collected immediately (during the 1976 season) by the ranger at Lee's Ferry.

Experimenting with the effects of something like an oars only policy would be more involved. It would require lead time to set up and a more extensive research effort (an abbreviated form of this study) to monitor. A trial period would be invaluable in determining the effects of this policy, and ideally should precede any across the board changes. A trial period might be set up for the 1977 season if this kind of policy is a possibility. It could be scheduled for the off-season (e.g., September) and filled by offering "free" user-days to outfitters and/or private users. It could always be cancelled if policy considerations made it unnecessary.

Computer Simulation

Another possibility for learning the effects of different policies is to construct a "simulation" model for use at Grand Canyon. This technique has been applied in several other wilderness settings.⁶ Given information about typical parties and their patterns of movement, a simulator allows exploration of different management options. It would be possible, for example, to double the "use" figure; the model would then work out a scenario in terms of the number and location of contacts. If simulation is to be applied to the Canyon, managers should insure that the simulator will allow exploration of different use distributions, in terms of use densities, trip types (motor or oar), or trip lengths. These are the areas where simulation would be most useful for the Grand Canyon.

It should be kept in mind that there is nothing magical about computer simulations. They are only as accurate as the "base-case" data they receive and the program parameters used to calculate estimates. Results should be checked against "real world" data to see if problems develop which simulation did not anticipate. The potential benefits are great, since "seeing" the effects of different management alternatives requires only computer time. Data required to set up a simulation for river trips in the Canyon were collected in the course of the River Contact Study.

FOOTNOTES

1. Although much of the material presented here is relevant to outdoor recreation in general, the present discussion is limited for the sake of clarity to wilderness-type areas. These are generally defined as areas in which there is little or no development, such as roads or buildings, and low densities of people.
2. The literature associated with crowding models and their applications to wilderness is reviewed in Shelby and Nielsen, 1975, and Nielsen and Shelby, 1976.
3. Heberlein suggested this application in his 1973 report to the National Park Service. It is further developed in Nielsen, Shelby, and Haas, 1976.
4. The "product shift" concept was suggested by George Stankey (personal communication).
5. Data were collected by Dr. Thomas Heberlein while he was teaching a section of the intake training session. He was kind enough to allow us to use them.
6. The simulation model was developed in California's Desolation Wilderness by the U.S. Forest Service and Resources for the Future. It has been applied to river running in Dinosaur National Monument by Steven McCool and David Lime (North Central Forest Experiment Station, St. Paul, Minnesota). Information can be obtained from these people or from Robert Lucas (Intermountain Forest and Range Experiment Station, Missoula, Montana).

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APPENDIX 1

TABLES AND FIGURES
NOT INCLUDED IN TEXT

TABLE A1

THE RIVER TRIP AS A WILDERNESS EXPERIENCE

	<u>Percent Agreeing with Statement</u>			
	<u>Overall</u>	<u>Commercial</u>		<u>Private</u>
		<u>Motor</u>	<u>Oar</u>	
I would consider the Grand Canyon area of the Colorado River a "wilderness."	91	91	93	87 NS
The Canyon is too crowded to be considered wilderness.	15	13	20	41 *
The Canyon would be more of a wilderness if use were more restricted.	43	39	64	55 *
The Canyon would be more of a wilderness if motor travel were banned.	44	35	80	91 *

While floating on the river, how many other parties would you prefer to see each day?

None	1	2	3	4	5	6 to 10	11 to 20
Percent in each category (n=926)							
34	15	16	13	7	8	6	2

If you had a choice, would you prefer a campsite

- | | | |
|---------------------------------------|---|---------------------------------------|
| 1) On the same beach as another party | 2) Where you might be able to see or hear another party | 3) Out of sight and hearing of others |
|---------------------------------------|---|---------------------------------------|

Percent in each category (n=948)

3	7	90
---	---	----

With which size of trip would you rather run the river?

- | | | | |
|-------------------------------|---------------------------|--------------------------|------------------------|
| 1) Small (20 persons or less) | 2) Medium (20-30 persons) | 3) Large (30-40 persons) | 4) Makes no difference |
|-------------------------------|---------------------------|--------------------------|------------------------|

Percent in each category (n=964)

57	29	4	11
----	----	---	----

* Percentages for the three groups are significantly different; $p < .001$.

TABLE A2

ATTITUDE TOWARD DEVELOPMENTS AND CONVENIENCES

	Percent Agreeing with Statement			
	<u>Overall</u>	<u>Commercial</u>		<u>Private</u>
		<u>Motor</u>	<u>Oar</u>	
More developments like Phantom Ranch should be built along the river.	10	11	6	3 NS
They should build an aerial tramway into the Canyon so more people could enjoy it.	7	8	4	0 NS
I would have preferred to have more of the "conveniences of home."	9	11	5	3 *
I would have enjoyed the trip more if we had better camping facilities.	12	14	5	2 *

* Percentages for the three groups are significantly different; $p < .001$.

TABLE A3

PERCEIVED CROWDING IN THE CANYON

		Percent Agreeing with Statement			
		<u>Overall</u>	<u>Commercial</u>		<u>Private</u>
			<u>Motor</u>	<u>Oar</u>	
General					
I don't think we met too many people during our trip down the river.	69	71	63	62	NS
Our trip would have been better if we had met fewer people along the way.	41	38	60	49	*
I would have enjoyed the trip more if there hadn't been so many boats going by.	26	21	48	56	*
On the River					
I would have enjoyed the trip more if we had seen less people while floating on the river.	31	27	52	51	*
It bothered me to meet so many people while floating on the river.	23	19	41	38	*
At Attraction Sites					
The places we stopped (like Redwall Cavern were often too crowded.	26	25	24	50	*
Too often we had to share a place like Deer Creek Falls with other groups.	26	24	28	48	*
I would have enjoyed the trip more if we had seen less people at side stops.	35	32	48	54	*
At Camp Sites					
Too often we had to camp near other parties.	7	6	9	11	*

* Percentages for the three groups are significantly different; $p < .001$.

TABLE A4

PERCEIVED IMPACT OF USE ON THE CANYON

	Percent Agreeing with Statement			
	<u>Overall</u>	<u>Commercial</u>		<u>Private</u>
		<u>Motor</u>	<u>Oar</u>	
The Canyon seems relatively unaffected by the presence of man.	78	82	65	46 [*]
The Grand Canyon environment is not being damaged by overuse.	75	80	53	43 [*]
(Degree to which each of these environmental damage conditions exists in the Canyon.)				
Excessive littter	11	8	21	24 [*]
Trampling of natural vegetation	18	14	31	38 [*]
Over-use of campsites	19	15	37	31 [*]
Over-use of visitor attraction sites (like Deer Creek Falls)	27	22	44	48 [*]

^{*} Percentages for the three groups are significantly different; $p < .001$.

TABLE A5

WILDERNESS NORMS FOR ALBRIGHT INTAKES

On the items below check the maximum amount of contact with other visitors you would tolerate before your trip down the Canyon would no longer be a wilderness experience. (Percent in each category is shown to the left of responses. N=39.)

1. Time spent in sight of other float trips.

- 5 - all day (8 hours)
- 3 - most of the day (6 hours)
- 3 - half of the day (4 hours)
- 5 - a quarter of the day (2 hours)
- 10 - one hour a day
- 0 - 45 minutes a day
- 13 - 30 minutes a day
- 13 - 15 minutes a day
- 8 - 5 minutes a day
- 0 - 1 minute a day
- 39 - any contact at all
- 3 - time spent in sight of other trips does not affect my perception of a wilderness experience

2. Number of other float trips seen in a day.

- | | | |
|---------|--------|-----------------------------------|
| 0 - 500 | 0 - 9 | 21 - 2 |
| 0 - 250 | 5 - 8 | 8 - 1 |
| 0 - 100 | 0 - 7 | 13 - less than one on the average |
| 0 - 75 | 3 - 6 | 23 - 0 |
| 3 - 50 | 8 - 5 | 0 - number of contacts does not |
| 0 - 25 | 0 - 4 | affect my perception of a |
| 8 - 10 | 10 - 3 | wilderness experience |

3. Nights spent camping in sight of other parties.
(Assume a 10-day trip.)

- | | | |
|--------|-------|--------------------------------|
| 0 - 10 | 0 - 6 | 8 - 2 |
| 0 - 9 | 8 - 5 | 10 - 1 |
| 0 - 8 | 3 - 4 | 64 - 0 |
| 0 - 7 | 3 - 3 | 3 - camping in sight of others |
| | | not affect my perception of |
| | | a wilderness experience. |

Table A5 (continued)

4. Number of people outside those in my own party seen on a typical day.

0 - 500	0 - 9	0 - 2
0 - 200	0 - 8	0 - 1
5 - 100	0 - 7	5 - less than one on the average
8 - 75	0 - 6	23 - 0
15 - 50	10 - 5	0 - number of people I see
13 - 25	0 - 4	does not affect my perception
15 - 10	0 - 3	of a wilderness experience

5. Probability of meeting 58 other people (outside your own party) at Havasu.

5 - 100%	0 - 40%	8 - 1%
3 - 90%	3 - 30%	5 - less than 1%
0 - 80%	15 - 20%	28 - 0%
3 - 70%	10 - 10%	3 - the chance of seeing others
0 - 60%	13 - 5%	at Havasu does not affect
0 - 50%	3 - 3%	my perception of a wilderness experience

6. Probability of meeting 36 other people (outside your own party) at the Little Colorado River.

5 - 100%	3 - 40%	8 - 1%
3 - 90%	8 - 30%	5 - less than 1%
0 - 80%	8 - 20%	28 - 0%
0 - 70%	8 - 10%	3 - the chance of seeing others
0 - 60%	10 - 5%	at the Little Colorado River
3 - 50%	5 - 3%	does not affect my perception
		of a wilderness experience

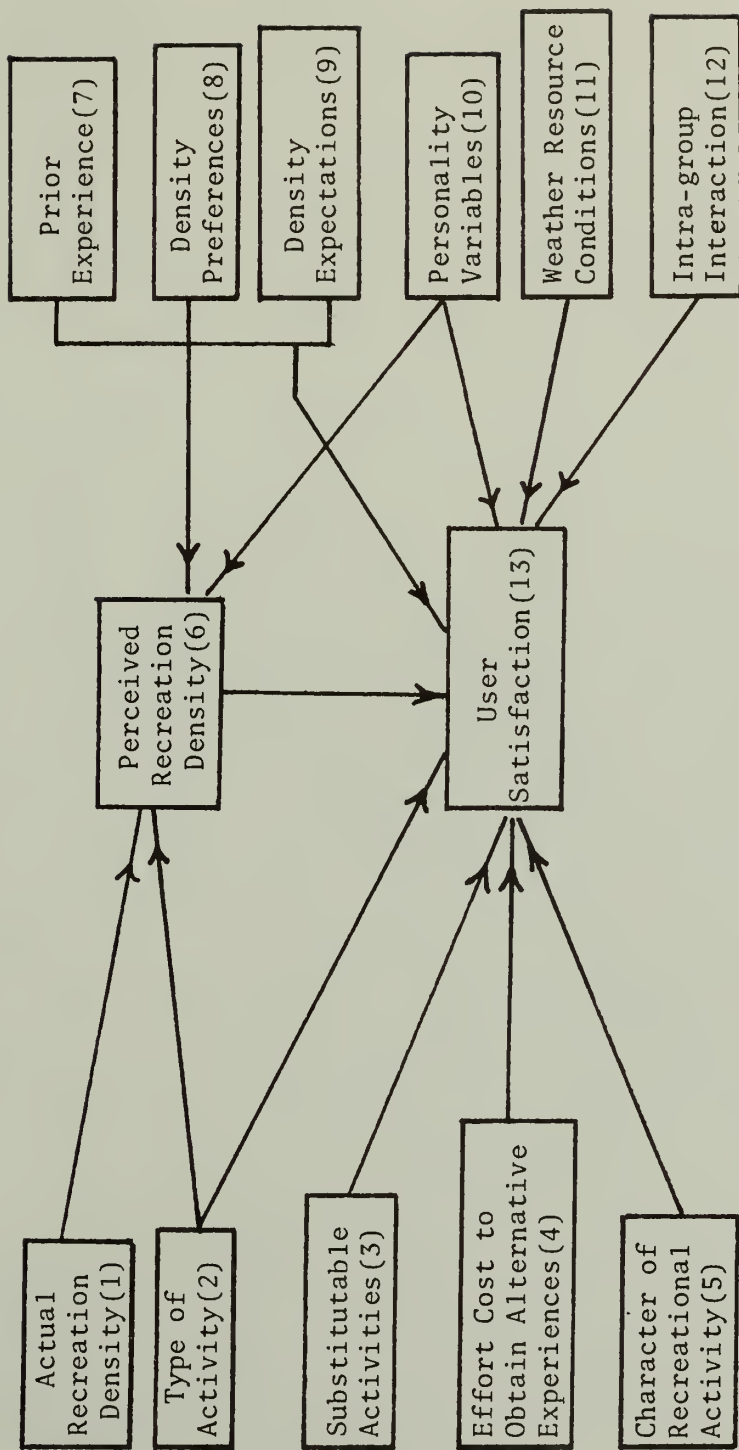
7. Probability of meeting 30 other people (outside your own party) at Elves' Chasm.

5 - 100%	3 - 40%	13 - 1%
3 - 90%	5 - 30%	5 - less than 1%
0 - 80%	5 - 20%	31 - 0%
0 - 70%	8 - 10%	3 - the chance of seeing others
0 - 60%	8 - 5%	at Elves' Chasm does not
8 - 50%	0 - 3%	affect my perception of a
		wilderness experience

Table A5 (continued)

8. Being on a motor powered (vs. an oar powered) trip would
- 13 - have no affect on the wilderness character of my trip
 - 8 - have a little affect
 - 13 - have some affect
 - 31 - have a large affect
 - 33 - would totally eliminate the wilderness character of
my experience

FIGURE A1
Factors Affecting Density, Perception, and User Satisfaction



--taken from Heberlein (n.d.)

