

Preferences of Recreation User Groups of the Colorado River in Grand Canyon

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EXECUTIVE SUMMARY

The research reported here is part of the monitoring effort sponsored by the Grand Canyon Monitoring and Research Center and linked to the Adaptive Management Program for the operations of Glen Canyon Dam. The assessments of this report are directed at attitudes and preferences of recreational user groups and stakeholders of the Colorado River ecosystem. The objectives of this study were directed at describing preferences for various flow-related setting characteristics. Specifically the objectives were:

1. Determine current attitudes and preferences of Colorado River users toward recreation opportunities and setting attributes related to river flows.
2. Evaluate changing attitude and preferences of Colorado River users.
3. Evaluate commonality and disparity of current user attitudes and preferences regarding proposed management directions.

The study involved two phases of data collection. The first phase assessed current stakeholder issues related to recreation within the Colorado River ecosystem. Its major tasks, which were conducted during summer/fall of 1998, involved contacting stakeholders to identify and prioritize issues linking river flow levels to recreational use. The issues identified in the first phase guided the second phase of data collection in which user attitudes and preferences were assessed. The major tasks of the second phase of data collection, which took place from fall 1998 through spring 1999, involved surveys of recreationists to assess their preferences for flow-related setting characteristics.

This research followed-up on the findings of Bishop et al. (1987) who studied relationships between flow release levels and recreational preferences of Grand Canyon white water rafters, Glen Canyon anglers, and Glen Canyon day-use rafters. During the early 1980s, release flows from the Dam varied widely on a daily basis, and were referred to as "fluctuating flows." A large portion of their study addressed user preferences related to flows that fluctuated more than 10,000 cfs within a 24-hour period. White water rafter satisfaction was highest at constant flows between 15,000 - 35,000 cfs, and several flow-related setting characteristics were rated highly important: stopping and hiking at side canyons, and running large rapids. They found that decreases in the number of camping beaches would have a substantial adverse impact due to recreational rafters having to share camping beaches with other groups. Angler satisfaction peaked at constant flows of 10,000 cfs, however anglers were still satisfied with constant flows up to 25,000 cfs. For day-use rafters, Bishop et al. (1987) reported that user satisfaction was independent of flow levels above 3,000 cfs. Several studies have indicated a decrease in the number and quality of beaches in the Colorado River ecosystem due to the adverse impact of Glen Canyon Dam. One of the objectives of the 1996 spike flow (beach habitat building flow or BHBF) was to enhance the number and size of beaches in the river corridor. Evidence indicates that immediately following the spike flow there was a net gain in beaches and that a substantial proportion of beaches increased in size.

The high priority stakeholder issues that emerged from phase 1 were related to spike flows and their effects on recreation opportunities, particularly as spike flows affect number, size, and other characteristics of beaches. Hence, this study emphasized user preferences for beach characteristics,

especially beach characteristics related to managerial influence such as size, presence of shade, and vegetation. Preferences for beach characteristics were primarily determined using photographs of beaches that were digitally manipulated to achieve the specific images required for the research design. For phase 2, the following five recreational user groups were surveyed using mailback questionnaires: private trip leaders, commercial outfitter patrons, commercial river guides, Glen Canyon Anglers, and Glen Canyon day-use rafters. Survey response rates ranged between 65% and 91%. During the time period of data collection, average daily flows ranged between 9,000 - 27,000 cfs. The principal conclusions of this study were the following:

1. *Glen Canyon Dam releases have substantial impacts on recreational opportunities in the river corridor.* Private trip leaders, commercial patrons, river guides, and anglers all reported preferences for various flow-related setting characteristics.
2. *The negative effects of fluctuating flows on recreational use were not substantial problems during the time period of this study.* Results of the stakeholder discussions concluded that fluctuating flow problems have been effectively addressed by the Record of Decision (1996).
3. *The recreational impacts of constant flow releases from Glen Canyon Dam were remarkable unchanged since the Bishop et al. (1987) study.* User attitudes and preferences regarding constant flows have not changed significantly in the past 15 years.
4. *The 1996 spike flow, as it affected beach development, was perceived as significantly improving recreational opportunities for rafters.* Spike flows are being promoted as a means to achieve an increase in number and size of beaches, and hence, they have considerable support amongst the recreational public.
5. *Large size beaches with shade from trees are setting characteristics with highly reliable and strong user preferences.* Across three user groups (private trip leaders, commercial patrons, and river guides) and across several segmentation variables (past experience, boat type, group size), respondents preferred beach campsites greater than 800 square meters that included shade from trees. In addition, the size of beach was consistently ranked from a series of setting characteristics as being moderately important by white water rafters.
6. *There is both commonality and disparity between user preferences and stakeholder directions.* Points of overlap between stakeholders and users were: concern over impact of spike flows, lack of interest in fluctuating flows, and an awareness that constant flows have a significant impact on recreational use. Points of disparity between user preferences and stakeholders were that some stakeholders resisted explicit linkages between BHBF and the enhancement of recreational quality. An expanded context of Dam operating decisions, which would more explicitly include recreational user preferences, would be embraced by some stakeholders and not by others.

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INTRODUCTION

The research reported here is part of the monitoring effort sponsored by the Grand Canyon Monitoring and Research Center (GCMRC) and linked to the Adaptive Management Program for the operations of Glen Canyon Dam. Recreational use of the Colorado River ecosystem, from the forebay of Glen Canyon Dam to the western boundary of Grand Canyon National Park (approximately 293 river miles), is related to several types of user groups and many different stakeholders. The assessments of this report are directed at monitoring attitudes and preferences related to recreational user groups and stakeholders.

Recreationists are attracted to the Colorado River through Grand Canyon for a variety of reasons, including its spectacular scenery and canyons, the beauty of Grand Canyon and its appeal as a world renown park, extended raft trips, sport fisheries, archeological resources, and opportunities to see wildlife in natural settings. During 1998, about 23,000 visitors took a raft trip downstream from Lee's Ferry spending between 3 to 21 days floating, camping, and day-hiking within the river's ecosystem. Most rafters engaged the services of one of the 16 commercial river outfitters, however about 23% floated on private trips and outfitted themselves. Opportunities for a day or half-day float trip occurred on the 15-mile river segment between Glen Canyon Dam and Lee's Ferry and are provided by a commercial outfitter; about 61,000 people floated the Colorado River in 1998 related to this day trip experience. In addition, the Glen Canyon reach of the Colorado River (with Lee's Ferry as the common base of departure) is famous for its rainbow trout fishery, and attracted about 22,000 anglers during 1998, and currently supports about 20 commercial fishing guide services.

This research effort views recreation user groups as important constituents of the Colorado River ecosystem through Grand Canyon. Due to their diffused nature as a constituency, representation of their many voices within policy forums is difficult. An ultimate goal of this study is to identify the preferences of several groups of recreationists, with this report serving as a partial representation of their perspectives as constituents in the Adaptive Management Program of Glen Canyon Dam.

In addition, there are several managerial and agency stakeholders of the Colorado River ecosystem through Grand Canyon. Glen Canyon National Recreation Area and Grand Canyon National Park are agencies that share administrative responsibilities for the Colorado River ecosystem downstream from Glen Canyon Dam. Other agencies and interested parties potentially relevant to long-term planning of the Colorado River ecosystem include: U. S. Geological Survey, U.S. Fish and Wildlife Service, various state agencies linked to water and wildlife resources of the Colorado River ecosystem, various private and non-governmental organizations linked to water and wildlife resources, environmental protection groups, commercial recreation interest groups, and several Native American tribes. Each of the several stakeholders has the potential to either affect, or be affected by, management directives for the

Colorado River, and thus, are essential to consider in the development of adaptive management strategies.

Objectives

The objectives of this study were directed at describing preferences for various flow-related setting characteristics. The preferences assessed in this study were primarily linked to recreation user preferences. The specific objectives of this study were:

1. Determine current attitudes and preferences of Colorado River users toward recreation opportunities and setting attributes related to river flows.
2. Evaluate changing attitude and preferences of Colorado River users. This evaluation characterizes trends from a past recreation user study of the Colorado River ecosystem, and also develops benchmarks using new assessment parameters. These benchmarks will be instrumental in identifying changing attitudes and preferences in future recreation-related monitoring studies.
3. Evaluate commonality and disparity of current user attitudes and preferences regarding proposed management directions of NPS and other agencies. The two-phase research design (described below) allowed for the assessment of both managerial and user-based information, and hence, allowed for some comparisons between managerial-derived and user-based attitudes and preferences.

This study involved two phases of data collection. The first phase assessed current stakeholder issues related to the Colorado River ecosystem. Its major tasks, which were conducted during summer/fall of 1998, involved contacting stakeholders to identify and prioritize issues associated with recreational opportunities and their relation to river flow levels. The issues identified in the first phase guided the second phase of data collection in which user attitudes and preferences were assessed. The major tasks of the second phase of data collection, which took place during fall 1998 and winter/spring 1999, involved surveys of recreationists who were linked to recreational opportunities identified in the first phase, and obtain attitudes and preferences regarding the provision of various mixes of recreation opportunities and desirable attributes (related to river flow levels) of each opportunity.

Past Research on Flow-related Recreation Opportunities

The Bishop et al. (1987) study, which was part of the Glen Canyon Environmental Studies, was “designed to identify the effects of a variety of flow release patterns from Glen Canyon Dam on Grand Canyon white-water boaters, Glen Canyon anglers, and Glen Canyon

day-use rafters” (p. 6). During the early 1980s, release flows from the Dam frequently varied widely (by more than 10,000 cfs) on a daily basis, referred to as a “fluctuating flow.” A significant portion of the Bishop et al. (1987) study addressed user preferences related to flows that fluctuated more than 10,000 cfs within a 24-hour period. Their data collection occurred during 1984 and 1985. They found that “Glen Canyon Dam releases have substantial impacts on white-water boating” (p. 170). Boater satisfaction was highest at flows between 15,000 – 35,000 cfs, and several flow-related setting attributes were rated highly important by their sampled boaters: stopping at side canyons, hiking at side canyons, and running large rapids. In addition, they found that “loss of large numbers of camping beaches would have a substantial adverse impact on white-water boating” (p. 170). Bishop et al. (1987) reported peaks in angler satisfaction around 10,000 cfs constant flow, however anglers were still relatively satisfied with constant flows up to 25,000 cfs. Compared to constant flows at the same level, angler satisfaction decreased dramatically in response to fluctuating flows between 10,000 and 25,000 cfs. For day-use rafters, Bishop et al. (1987) reported that user satisfaction was independent of flows levels (regardless of constant or fluctuating) above 3,000 cfs.

In their study of both river guides and private trip leaders, Shelby, Brown, and Baumgartner (1992) found a relationship between user satisfaction and hypothetical scenarios related to flow levels (see also Moore, Wilkosz, & Brickler, 1990; Shelby & Whittaker, 1995). For commercial motorized, commercial oar, and private trips, the highest ratings of satisfaction were reached at 20,000 - 25,000 cfs. They also found that rafters were sensitive to flow levels regarding their willingness to “row more” or “run motor more” in response to low river flows. In response to high river flows, they reported more than 75% of all rafter types would stop at additional attractions and spend more time at attraction sites.

In their study which applied the Lucas-Shechter Wilderness Use Simulation Model coupled with a survey of river guides, Underhill and Borkan (1986) also indicated that high river flows were associated with more time at attraction sites, more time to stop at additional attractions, and less delays at rapids. In one of the earlier studies of Colorado River users in Grand Canyon, Shelby and Nielsen (Report 2, 1976) suggested that increased river flows could affect the number of encounters at attraction sites, and hence the level of perceived crowding. They indicate that the distribution of use is a key consideration when managing a river for recreation opportunities (Shelby & Nielsen, Report 2, 1976, p. 40), and that distribution of use is linked to the speed of the river current: as flow increases, speed of downstream travel increases, which allows more time to stop at attraction sites.

Past research of the Colorado River ecosystem has indicated that attitudes and preferences for recreation setting attributes relevant to flow level may include delays at rapids, speed of travel, time spent floating, time spent at attractions, arrival time at campsites, size and number of beaches, and perceptions of safety (Shelby, Brown, & Baumgartner, 1992; Underhill & Borkan, 1986). In addition, flow-related attributes of the Colorado River ecosystem have been

demonstrated to have a high priority even for people who do not use the river for recreational purposes (Harpman, Welsh, & Bishop, 1995; Welsh, Bishop, Phillips, & Baumgartner, 1995).

Rather than focus on user experiences and preferences, several studies have examined changes in settings attributes relevant to both recreational use and dam operations. In general, these studies indicated a decrease in the number and quality of beaches (also referred to as “sandbars”) as an adverse impact of Glen Canyon Dam operations. In their study which examined a 20-year trend of beaches in the Colorado River ecosystem in Grand Canyon, Kearsley and Warren (1993) indicated “that campsites have dramatically decreased in both number and size in the past 20 years” (p. 1). In their comprehensive review of the downstream effects of Glen Canyon Dam, Webb et al. (1999) stated that “60% of all sandbars had eroded between 1890 and the early 1990s” (p. 12). One of the objectives of the 1996 spike flow was to enhance the size of beaches within the Colorado River ecosystem (Schmidt et al., 1999). According to Kearsley, Quartaroli, and Kearsley (1999) there was a net gain of 81 new beaches immediately following the 1996 flood, and a substantial proportion of beaches increased in size (see also Thompson, Burke, & Potochnik, 1997). Although the long-term durability of the effects of spike flows is an open question, there has been ample and non-controversial evidence indicating that dam operations have resulted in decreased number of beaches and that the 1996 spike flow resulted in an immediate improvement in the number and size of camping beaches.

PHASE 1: STAKEHOLDER ANALYSIS

The methods of the first phase were directed at assessing information, and learning about issues, from stakeholders associated with the Colorado River ecosystem. The issues and concerns emerging from this first phase served as a partial basis to develop the survey instruments for the user studies of the second phase.

There were various discussion forums in which stakeholder issues related to recreation were assessed. The research team, along with several other researchers who have studied aspects of the Colorado River ecosystem in Grand Canyon, took a river trip from Lee's Ferry to Diamond creek during July, 1998 to observe recreational use and conduct informal face-to-face interviews with rafters. In September, 1998, a principal investigator presented an overview of the research project at a scheduled meeting of the Technical Work Group (TWG; see Appendix F for a list of participants) and collected information (formally at the technical presentation, informally at a workshop after the presentation, and after the TWG meeting through follow-up phone calls) about stakeholder issues and concerns related to recreational use. In addition, the research team participated in the annual meeting of the Grand Canyon River Guides in November, 1998, to provide them with an overview of recreation research, to identify setting attributes relevant to expert river runners, and to pilot test the use of photographic imagery to represent beach characteristics.

In addition, there were several researchers contacted during Fall 1998 who had conducted studies on the Colorado River through Grand Canyon. The group of researchers contacted who were most relevant to this study were the staff from the Northern Arizona University (NAU) Sandbar Studies who provided insight on issues related to development and erosion of beaches within the river corridor (Kaplinski, Hazel, & Beus, 1995). Along with their insight on sandbar development, the continuous database of sandbar change archived by the NAU group provided photographic images that depicted visual effects (from a sample of beaches) of the 1996 spike flow from Glen Canyon Dam (e.g., website: <http://vishnu.glg.nau.edu/gces/studysites.html>; see also Kearsley, Quataroli, & Kearsley, 1999), and ultimately provided the base images for use in this study.

Two general issues emerged from the stakeholder discussions, along with several specific linkages between recreation opportunities and flow-related setting characteristics. The two general issues were the following:

- (1) There was general consensus that problems related to wide fluctuation in daily flows released from Glen Canyon Dam had been resolved by the Record of Decision (ROD, 1996) that put maximum limits, from 5000 – 8000 cfs depending on monthly release volume, on the allowable level of fluctuation within a 24 hour period. The recreational use problems related to fluctuating flows during the

early 1980s, in which flows would fluctuate more than 20,000 cfs within a 24-hour period, were addressed by the ROD. During discussion with stakeholders, there was broad agreement that the current level of daily flow fluctuation was a non-issue, was not controversial, and that most stakeholders were comfortable with current operations of Glen Canyon Dam regarding the daily fluctuations of release flows.

- (2) Another issue with general agreement concerned the need for more information about the impact of Beach Habitat Building Flows (BHBF, referred to as “spike flows”). There was a general feeling that spike flows would be re-occurring on a periodic basis, and most stakeholders felt that the effects of future spike flows needed careful monitoring and research. In addition, there was general agreement that spike flows had an impact on sandbar (or beach) characteristics, but the ability to predict the impact on any given beach was difficult to determine.

There also were some specific issues involving recreational opportunities and experiences that emerged from the discussions with stakeholders.

- (3) Several stakeholders expressed concern that the number and quality of beaches within the Colorado River corridor were an issue. Of these stakeholders, the general perception was that the number of useable beaches had been decreasing across the past few decades. There were mixed impressions of whether the beaches had increased or decreased in quality; some beaches were thought to have increased in quality and others were thought to have decreased in quality. There were mixed impressions regarding the importance of beach characteristics; some stakeholders felt that beach characteristics were not as important compared to social relationships and weather; whereas others indicated that the quality of beaches in the river corridor were quite important to a high quality raft trip. Some of the implications of fewer number of beaches (and poorer quality of beaches for camping) were an increased competition for campsites, increased potential to share camp with other groups or to be within sight and sound of other groups while camping, and increased potential for both inter-group and intra-group crowding at camp. “Critical reaches” were identified within the river corridor which are near attraction sites (e.g., Phantom Ranch, Havasu Falls, and Deer Creek Falls), have a scarcity of usable beaches, and have a high potential for erosion of beaches. Private rafters who are not as familiar with the river corridor compared to commercial river guides may have more on-river anxiety regarding the daily decision to select a beach for camping particularly in the critical reaches. In addition, shade and vegetation on beaches were considered important for protection from sun and wind, and for providing privacy and visual screening.

- (4) There were a number of different characteristics that stakeholders used to define a high quality beach for recreational rafting, and these characteristics often were expressed in the context of on-river decisions to camp or lunch. Salient characteristics of beaches, emerging from discussions with stakeholders, were the following and are grouped according to whether they can be managerially influenced:

Partially influenced by managerial or dam operations:

- beach size
- presence of shade
- vegetation on the beach
- exposed rocks on beach
- approach to the beach regarding ease of mooring

Low potential for influence by managerial or dam operations:

- location relative to attraction sites
- location relative to trip schedule
- nearby side canyons

- (5) Flow level, rather than fluctuating flow levels, was an issue for some stakeholders. Stakeholders interested in fishing indicated preferences for lower flows than stakeholders concerned about recreational rafting. Accessibility and/or presence of certain fishing “holes” was indicated as being best at lower flow levels, such as 10,000 - 12,000 cfs. Recreational rafting had both a broader range of flow levels and a higher range for “best” conditions, such as 18,000 - 25,000 cfs. These results converged to a large extent with the optimum constant flow levels reported by Bishop et al. (1987) for anglers and rafters.

From the results of the stakeholder analysis, it was clear that flow-related issues had changed since the Bishop et al. (1987) study. Daily fluctuation of flows was no longer a priority issue for most recreational use (Potochnik, 1998). Although Glen Canyon anglers are probably most affected by the level of flow fluctuation, the reduced level of variability since the ROD of 1996 greatly reduced the adverse impacts of fluctuating flows on anglers. In fact, by the classification used by Bishop et al., the current level of daily flow variability would not even be considered “fluctuating” since it varies by less than 10,000 cfs in a 24-hour period (Bishop et al., 1987, p. 187). Whereas the previous study had emphasized user preferences and reaction to various fluctuating flow regimes, this study did not consider assessment of such preferences as being the top priority issues for stakeholders. However, while fluctuating flows are not currently

a top priority issue, the effects of flow regimes on boaters after a period of low run-off years, and consequent reductions in average flows, is unknown.

The current high-priority stakeholder issues were related to spike flows and their effects on recreation opportunities in the river corridor, particularly as they affect the shape, size, and other characteristics of beaches (Harpman & Jalbert, 1997; Kearsley & Warren, 1993; Thompson, Burke, & Potochnik, 1997). This study emphasized user preferences for beach characteristics, especially beach characteristics related to managerial influence such as beach size, presence of shade, and vegetation. In addition, this study obtained preferences for various flow levels related to a safe and enjoyable trip to be compared with results from Bishop et al. (1987).

There were three specific research questions that emerged from the stakeholder discussions and served as primary driving forces in the development of questionnaires for this study:

- (a) What is the relative importance of flow-related characteristics compared to other setting attributes?
- (b) What are user preferences for minimum, maximum, optimum, and constant flow levels for the Colorado River?
- (c) What are user preferences for beach characteristics regarding places to camp or lunch?

PHASE 2: SURVEYS OF RECREATION USER GROUPS

Five different recreation user groups were surveyed for this assessment of user preferences: private trip leaders, commercial outfitter patrons, river guides, anglers at Lee's Ferry, and day-trip rafters in Glen Canyon. This is not an exhaustive list of recreation user groups of the Colorado River ecosystem in Grand Canyon, but these five groups were the ones addressed by Bishop et al. (1987) and still are considered the major recreation users of the river. The assessment methods shared some similar implementation across the five user groups.

Implementation of Methods

A section of the questionnaires related to rafters employed photographic imagery to assess user preferences for the quality of beaches. Salient characteristics of beaches for recreational use were developed during the first phase of this study, and emerged from discussions with various stakeholders that emphasized the need to monitor the effects of spike flow releases. In a general sense, sampled rafters responded to a series of photographs of possible camping and lunch sites in the river corridor. These photographs were computer-calibrated by the Imaging Systems Laboratory at the University of Illinois which enabled the examination of preferences for selected beach characteristics (Orland, Daniel & Haider, 1994).

Computer-calibrated imagery has been successfully employed elsewhere to assess user preferences for a variety of setting characteristics associated with crowding, conflict, and environmental impacts (e.g., Grand Canyon, Arches, and Acadia; see Manning et al., 1996; Manning, Lime, & Hof, 1996; Manning et al., 1999; Orland, 1993). Also, there has been an accumulation of studies that, given certain conditions, support the validity of responses to photographs as representative of responses to actual environments (e.g., Hull & Stewart, 1992; Orland, Vining, & Ebreo, 1992; Thuresson, Nasholm, Holm, & Hagner, 1996; Vining & Stevens, 1986; Zube et al., 1987).

Preferences for beach characteristics were primarily determined using photographs of beaches that were digitally manipulated to achieve the specific images required for the design (i.e., computer-calibrated). The characteristics of beaches manipulated were size of beach, presence of shade tree, and presence of low growing vegetation on the beach. Beach size was a continuous variable in the visual enhancements ranging from about 400 to 1300 square meters. Shade and vegetation were considered binary (either present or absent).

The base design consisted of 24 photographs arranged in 12 pairs according to a statistical design insuring balance on all characteristics. The 12 pairs were blocked into three sets (labeled as G, H, and I) of four pairs such that each set of four contained a full range of each characteristics. Each sample of rafters was randomly divided into thirds and assigned to one of the three sets of images. Two additional pairs of photographs were constructed varying size in a

specific way, and these were made common to all three sets of images. Thus each respondent was presented with a set of six pairs of photographs; the sets were balanced with respect to each study characteristic and the base photos. The images used in the study are shown in the questionnaires which are included in the appendices to this report; the images of the appendices are the exact size that were included in questionnaires sent to respondents.

For each of the six pairs of photographs, respondents were asked to choose between the two as a site for camping and as a site for lunch. They also had the option of choosing neither of the two and continue down-river for a better site. It is assumed that the choices respondents made reflected the alternatives that best served their needs, that is the alternatives with highest utility for them.

Random utility theory (McFadden, 1974) is a mathematically sound theory of discrete choice behavior that has been empirically tested and validated in a wide range of applications. The multinomial logit (MNL) model derived from random utility theory is the most common, and it is the model used here. In brief, the utility U for a site is assumed to be a function of its size, shade, and vegetation (the utility for “neither” is a constant). For any individual respondent there is also an error of measurement of the utility which is considered random (hence random utility theory), or

$$U = V + e$$

where V is the true systematic component of the utility and e the random error component. The MNL model gives the probability of choosing site A from a choice of set $S = \{\text{Site A, site B, Neither}\}$ as

$$P(\text{Site A} | S) = e^{U_A} / \{ e^{U_A} + e^{U_B} + 1 \}$$

The choices made by respondents are the data required to estimate the parameters of the MNL model, sometimes referred to as a conditional MNL. Since the MNL model is nonlinear, an iterative maximum likelihood estimation (mle) procedure is employed. The mle produces parameter estimates along with standard errors and approximate t -statistics. Overall model fit is measured with a McFadden’s Rho Square (or R^2). Values of this Rho Square between 0.3 and 0.5 are “reasonable to good,” between 0.5 to 0.8 are “good to excellent,” and over 0.8 are “excellent” (Intelligent Marketing Systems, 1994, p. 7-12). For these data the overall fit was generally in the good to excellent range.

Several items contained in the mailback questionnaires (see Appendices) were identical to the items used by Bishop et al. (1987). Employment of items used in the previous assessment enhances the validity of interpreting changes in attitudes and preferences of recreationists, a major study objective. In addition, employment of items related to Shelby and Nielsen’s studies in the 1970s also were used to assess attitudes and preferences for setting characteristics relevant

to river flow levels (Shelby, Brown, & Baumgartner, 1992; Shelby & Nielsen, Reports 1, 2, 3, and 4, 1976); thus, not all items contained in this study will have a comparison point with the Bishop et al. (1987) study.

Survey Administration Procedures

For all user groups of this study, survey administration of mailback questionnaires employed the widely-accepted standard procedures prescribed by Dillman's Total Design Method (1978), which included the following steps:

1. An initial mailing was sent that included a questionnaire and self-addressed postage-paid return envelope, along with a cover letter explaining the study, how they were sampled, and invited the sampled visitor to complete the questionnaire.
2. One week after the initial mailing, a "thank you/reminder" postcard was sent to each sampled visitor encouraging them to respond and thanking those who already completed and returned their questionnaire. If the addressee had misplaced their questionnaire, or had comments about the study, the text on the postcard invited them to call-collect the Department of Leisure Studies, University of Illinois to request a replacement questionnaire or to clarify their concerns.
3. For non-respondents, three weeks after the initial mailing, a second questionnaire was sent that included a self-addressed postage-paid return envelope and cover letter.
4. For persistent non-respondents, seven weeks after the initial mailing, a third questionnaire was sent that included a self-addressed postage-paid return envelope and cover letter.

The guiding principle of the Dillman technique involves personalizing the appearance of the survey. Addresses on the envelopes were handwritten in blue-ball point pen for each sampled visitor, with postage stamped rather than metered. Cover letters were addressed to the interviewee with a signature in blue ball-point pen at the bottom. All stationary was letterhead from the Department of Leisure Studies, University of Illinois. Telephone calls and phone messages from sampled visitors were answered promptly with follow-up directed at sending replacement questionnaires or providing further information about the study.

All respondents were assured in their cover letter that their responses would be aggregated with other sampled visitors, and that their names would not be associated directly with their responses. A database was developed to track the responses of all sampled visitors. The tracking system accounted for returned and completed questionnaires, undeliverable

addressees, deceased persons, and refusals. Questionnaires were coded and entered into a database that was separate from the database of the names and addresses of respondents. As a final stage of survey administration, datasets were cleaned to identify missing data, wrong values, or other invalid codes.

Responses to open-ended questions were coded as text using a standard statistical software package for the social sciences (SPSS version 8.0, 1998). There were several short open-ended items on the questionnaires that were coded as text, and then reviewed for themes during analysis. Themes were developed by going through a listing of text a few times and identifying topics that would subsume several responses. For example, directly following the photographic images of beaches, the questionnaires contain an open-ended item that asked respondents if they had comments about beaches they prefer or if they had comments on the photographs just examined. Two responses such as “the bigger the beach the better” and “I like big camping and lunch spots” would be grouped under the label “prefer big beach” due to their similar meaning. After responses had been grouped into themes, the themes were then coded and percentages developed for proportion of respondents stating a given theme. For the long opened-ended item at the end of each questionnaire, which asks respondents if they have any other comments, responses were compiled verbatim and presented in the Appendices.

Surveys of White Water Rafters

This section presents results of two samples of white water rafters who floated the Colorado River during 1997 and 1998 downstream from Lee's Ferry: (1) private trip leaders and (2) commercial outfitter patrons.

A list of trip leaders (people who applied and used a permit for a private river trip) was obtained from Grand Canyon National Park. There were 219 names and addresses of trip leaders for 1997 and 268 trip leaders for 1998. In total, 348 private trip leaders were randomly sampled and sent questionnaires; 35 were returned as undeliverable, 2 returned the questionnaire and refused to participate, 1 was sent to a deceased individual, and 245 returned completed questionnaires resulting in a 79% response rate (Table 1).

Table 1. Private Trip Leader and Commercial Patron Response Rates

	Private Trip Leaders	Commercial Patrons
Completed questionnaires	245	167
Undeliverable addresses	35	7
Refused to participate	2	0
Deceased respondents	1	0
Total questionnaires mailed	348	190
Adjusted Response Rate*	79%	91%

* Adjusted response rate was arrived at by dividing the number of completed questionnaires into the total questionnaires mailed, less the number of questionnaires returned with undeliverable addresses and the number of deceased respondents. Those who refused to participate are considered non-respondents in the calculations.

There were close to 19,600 people who took commercially guided raft trips in both 1997 and 1998, with about 75% being on motorized trips and 25% on non-motorized trips. The average fare per person per day on a commercial raft was about \$215 in 1999. The demand for commercial raft trips is high, with most commercial trips generally 90% booked-up one year in advance.

Since there was no convenient list of patrons from commercially guided raft trips, the sample of patrons was drawn in cooperation with commercial outfitters and the assistance of Grand Canyon Commercial Outfitter Association. All 16 commercial outfitters were contacted about this study and their potential role in it. Names and addresses of their passengers were requested from each outfitter in proportion to their allocation of user-days, which ranged from 13 to 55 names being requested from any one company. In the requests, outfitters were asked to select names and addresses that would be representative of their passengers, particularly

regarding the time of floating. An example given was that if half of your clients float the river in June, then about half of the names sampled should have floated in June. There were 12 of the 16 outfitters who agreed to send names and addresses of their passengers which resulted in 318 names and addresses. A random sample of 190 passengers was selected from these 318 names. Of these 190 passengers who were sent questionnaires, 7 had undeliverable addresses, and 167 completed questionnaires were returned, resulting in a response rate of 91% (Table 1).

For 1997, the range of average daily flows for the high-season summer months (May through August) was 18,000 to 26,000 cfs; the range of average daily flow for all of 1997 was 16,000 to 27,000 cfs. For 1998, the range of average daily flows for the summer months was 9,000 to 21,000 cfs (and if not for a few days in May with low average daily flows, the remainder of the summer months did not go below 14,000 cfs); the range of average daily flow for all of 1998 was also 9,000 to 21,000 cfs. Thus these samples of private trip leaders and commercial outfitter patrons experienced average daily flows between 9,000 to 27,000 cfs, with the vast majority of respondents experiencing average daily flows between 16,000 and 26,000 cfs. In contrast, the average flows related to the Bishop et al. (1987) were high during 1984-1985 with peaks in the 40,000 – 50,000 cfs range; however to include rafters who experienced low average daily flows in their sample, in one of their surveys Bishop et al. (1987) included white-water boaters from May, 1982 in which average flows were less than 10,000 cfs.

The results are organized around the three research questions related to: (1) relative importance of setting attributes, (2) perceptions of flow levels, (3) and preferences for beach characteristics. Where possible, results are compared with the findings of Bishop et al. (1987). See Appendices A and B for copies of the private trip leaders and commercial passenger questionnaires with frequency distributions of their responses.

Relative Importance of Setting Attributes

At the beginning of the questionnaires, sampled trip leaders were presented with two open-ended items asking them to identify things that “would contribute most to an excellent or perfect raft trip” and that “would contribute most to a poor raft trip;” commercial passengers were presented with the item about a perfect raft trip. The focus of interpretation of trends in Tables 2 and 3 should be on the *relative rankings* of setting attributes between this study and Bishop et al. (1987); since the question was open-ended and relied on respondents to volunteer their reports, absolute comparisons between the two studies is not reliable. Across both studies, the top attributes for the patrons were good guides, good weather, and good social interaction, and for the private trip leaders the top attributes were good social interaction, good weather, and no crowding. See Table 2 for a ranking of attributes for a perfect trip and Table 3 for a ranking of attributes for a poor trip.

Table 2. Attributes for a Perfect Raft Trip

Attribute	Proportion Citing Attribute					
	Commercial Oar Patrons		Commercial Motor Patrons		Private Trip Leaders	
	1987	1999	1987	1999	1987	1999
Good weather	33%	25%	38%	28%	34%	21%
Good social interaction	22	38	29	34	51	41
Good guides	44	36	41	35	10	0
Unrushed pace/more layovers	29	29	27	17	26	19
Wilderness experience	27	29	19	16	29	16
Well conducted trip	16	18	28	15	30	35
Good food	24	27	26	10	17	5
Good/exciting rapids	22	11	20	15	13	9
Being in the Grand Canyon	13	0	26	5	15	6
No crowding	19	11	11	6	22	30

Table 3. Attributes for a Poor Raft Trip

Attribute	Proportion Citing Attribute	
	1987 Private Trip Leaders	1999 Private Trip Leaders
Crowding	41%	43%
Bad weather	25	19
Poor guides	9	1
Poor social interaction	33	50
Litter	20	9
Unsafe conditions	31	33
Low water level	14	12

To provide a context to understand the effects of flow-related attributes on recreation experiences, assessing the relative importance of various setting characteristics is useful. The questionnaire contained a set of items related to setting attributes and asked respondents to “indicate how important each feature was for you on your trip.” The importance rankings of this study were similar to the rankings reported by Bishop et al. (1987). Several of the flow-related items were moderate to very important trip attributes for rafting.

Table 4. Importance Ratings of Trip Attributes for Rafting

Attribute	Overall Ratings*					
	Commercial Oar Patrons		Commercial Motor Patrons		Private Trip Leaders	
	1987	1999	1987	1999	1987	1999
Being in a natural setting	3.0	n/a	2.9	n/a	3.0	n/a
Relaxing, getting away from it all	2.7	2.7	2.7	2.6	2.8	2.8
Confidence in my guide or trip leader	2.7	n/a	2.8	n/a	2.5	n/a
Observing flora, fauna, and geology	2.7	2.7	2.7	2.7	2.7	2.9
Being on the Colorado River	2.6	2.9	2.6	2.7	2.6	2.7
Learning about the history of the Grand Canyon	2.5	2.7	2.7	2.7	2.6	2.5
Seeing wildlife	2.5	2.5	2.5	2.4	2.6	2.6
Being with family and friends	n/a	2.2	n/a	2.6	n/a	2.8
Photographing the Grand Canyon	n/a	2.3	n/a	2.4	n/a	2.2
Seeing few people while floating	n/a	2.6	n/a	2.2	n/a	2.4
Floating on quiet stretches of river	n/a	2.6	n/a	2.3	n/a	2.6
Camping at sites without evidence of soil and vegetation damage	n/a	2.6	n/a	2.5	n/a	2.5
Visiting archaeological sites	n/a	2.3	n/a	2.4	n/a	2.4
Feeling safe	n/a	2.4	n/a	2.5	n/a	2.1
Eating good food	n/a	2.3	n/a	2.4	n/a	2.4
Interacting with others on my trip	n/a	2.4	n/a	2.5	n/a	2.6
Finding a spot for lunch with a shade tree	n/a	2.0	n/a	2.0	n/a	1.8
Places along the river without trash or litter	n/a	3.0	n/a	2.9	n/a	2.9
Fishing in the Grand Canyon	n/a	1.1	n/a	1.0	n/a	1.4
Flow-related items:						
Seeing few people at attractions	n/a	2.6	n/a	2.3	n/a	2.4
Stopping at side canyons or creeks	2.9	2.8	2.8	2.9	2.9	2.9
Hiking in the side canyons	2.7	2.8	2.7	2.7	2.8	2.8
Large rapids	2.7	2.6	2.7	2.5	2.6	2.5
Large beaches for camping	n/a	2.0	n/a	2.1	n/a	2.2
Camping on beaches with large boulders	n/a	1.4	n/a	1.5	n/a	1.3
Being the only group camping at a beach	n/a	2.6	n/a	2.6	n/a	2.6
Beaches without low growing shrubs	n/a	1.4	n/a	1.4	n/a	1.6

* Overall ratings are based on a scale of 1= not important to 3= very important.

Following from Bishop et al. (1987), patrons were asked about whether various characteristics of rapids increased or decreased the enjoyment of their trip. The sampled patrons were given a list of 15 attributes specific to rapids and asked whether each one increased, decreased, or did not matter to their enjoyment. The five attributes most important to increasing enjoyment are reported within Table 5 and were almost identical in proportion to those reported by Bishop et al. (1987).

Table 5. Attributes of Rapids Affecting Enjoyment for Commercial Patrons

Attribute	Proportion Citing Attribute			
	Commercial Oar Patrons		Commercial Motor Patrons	
	1987	1999	1987	1999
Increasing enjoyment:				
Rapid with large waves	90%	94%	95%	90%
Roller coaster ride	91	96	95	95
Long rapid	92	94	94	91
Large number of rapids	91	93	92	93
Learning how to “read” rapids from the guide or trip leader	87	87	85	84
Decreasing enjoyment:				
Having to walk around a rapid	81%	n/a	83%	n/a
Waiting at a rapid for other trips to run it	48	45	51	34
Fear of falling out of boat and being in the water for long time	45	n/a	33	n/a
Concern about damage to personal equipment	36	24	26	20
Rocks sticking out of water	31	24	25	19

Perceptions of Flow Levels

Private trip leaders were asked to evaluate their satisfaction with constant flow levels between 2,000 and 80,000 cfs on a 5-point scale ranging from “very unsatisfactory” to “very satisfactory.” Responses were nearly identical to the responses from Bishop et al. (1987) and reflected a bell-shaped curve as shown in Figure 1. Below 5,000 cfs responses were very unsatisfactory. Above 10,000 cfs and below 40,000 cfs, responses were above the midpoint of the satisfaction scale (i.e., a satisfaction level of 3) and considered as satisfactory or very satisfactory constant flows. Peak levels of satisfaction ratings, for both the previous study and this one, occurred between 20,000 and 25,000 cfs.

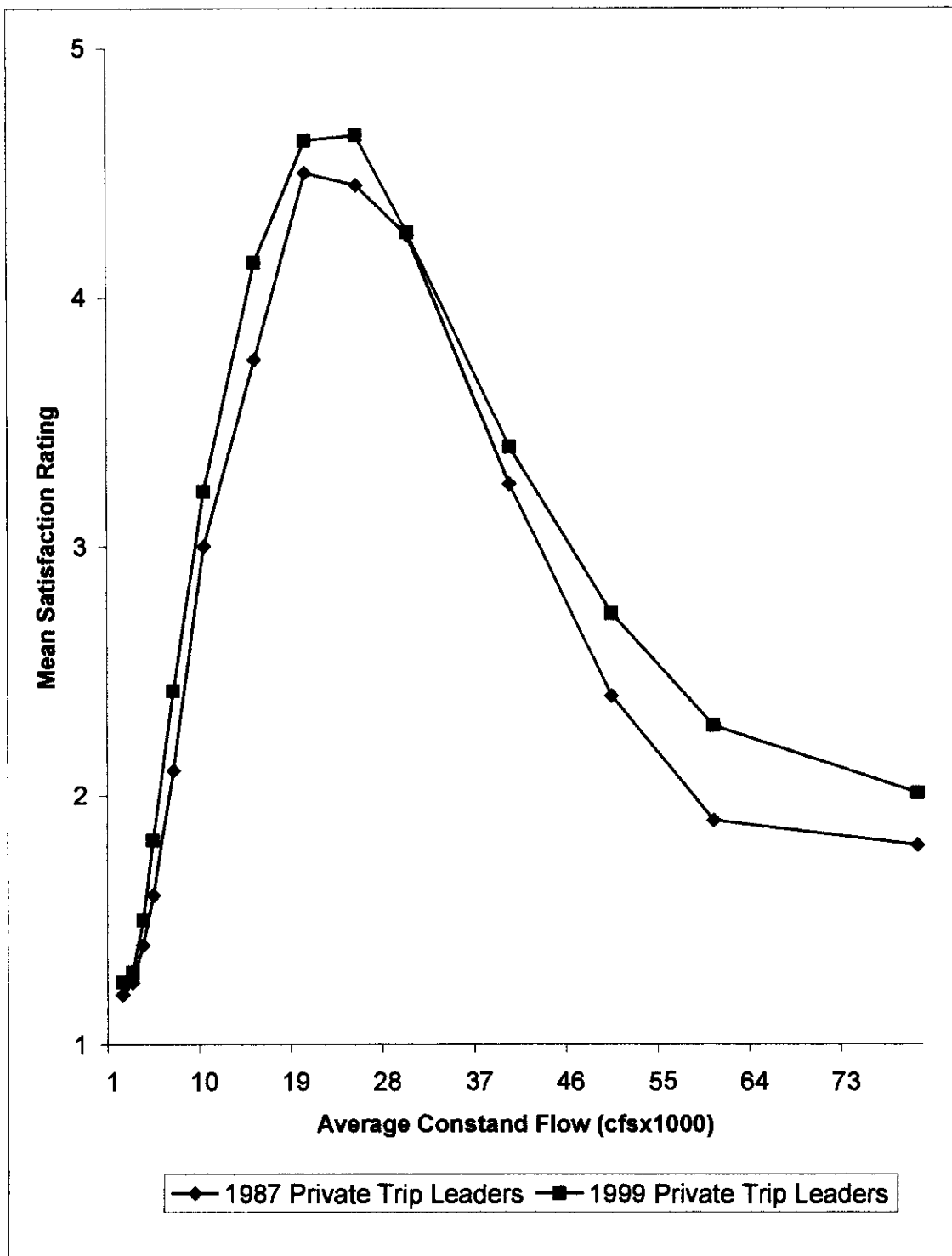


Figure 1. Private Trip Leaders' Satisfaction at Constant Flows

Private trip leaders also were asked to state the level of constant flow that “you prefer as a trip leader.” Table 6 indicates that the mean of their responses was 22,686 cfs which was 10% lower than the 25,158 cfs reported by Bishop et al. (1987).

Table 6. Preferred Constant Flow Levels

Flow	1987 Private Trip Leaders	1999 Private Trip Leaders
Preferred flow:		
Mean	25,158 cfs	22,686 cfs
Standard Deviation	7,515	8,029
Sample Size	145	201

Preferences for Beach Characteristics

Commercial patrons and private trip leaders preferred larger beaches to smaller beaches for camping, and size of beach was the strongest of the three setting attributes for camping. For lunch preferences there was a significant negative quadratic coefficient (utility function concave downward), and the maximum preference for size is about 1,000 square meters. Shade was a highly significant attribute for both camping and lunch, however both groups were relatively indifferent to the presence of vegetation. Tables 7 through 10 present MNL results for private trip leaders’ and patrons’ camp and lunch choice models. Figure 2 plots share of choice against size for patrons and privates and for both camping and lunch. The fact that both lunch curves are above the camping curves until the very largest size reflects that the respondents were more willing to accept lunch sites despite their characteristics than campsites (larger intercepts), and that the sensitivity to size is less for lunch sites.

Additional MNL analyses also were conducted which segmented the sample based upon the level of past rafting experience, whether oar or motorized, and whether the group size was large or small. With few exceptions, the segmentation variables were not significant nor were their interactions with the three primary variables of interest (e.g., experts were similar to novices in their sensitivity to beach characteristics and choice of camping and lunch sites).

Table 7. Preferences for Beach Characteristics: Private Trip Leaders’ Camping Decisions

Multinomial Logit Estimations	Parameter Estimate	SE of Parameter	t	p
Intercept	1.163	.094	12.348	.0000
Size (linear)	.062	.005	13.596	.0000
Size (quadratic)	-.001	.000	-2.621	.0088
Shade	.462	.045	10.238	.0000
Vegetation	.020	.044	.450	.6530
Adjusted McFadden’s Rho ²	.774			

Table 8. Preferences for Beach Characteristics: Private Trip Leaders' Lunch Decisions

Multinomial Logit Estimations	Parameter Estimate	SE of Parameter	t	p
Intercept	1.460	.105	13.888	.0000
Size (linear)	.028	.004	6.959	.0000
Size (quadratic)	-.001	.000	-3.796	.0001
Shade	.399	.041	9.817	.0000
Vegetation	.065	.040	1.622	.1049
Adjusted McFadden's Rho ²	.716			

Table 9. Preferences for Beach Characteristics: Commercial Patrons' Camping

Multinomial Logit Estimations	Parameter Estimate	SE of Parameter	t	p
Intercept	1.040	.110	9.435	.0000
Size (linear)	.060	.005	11.223	.0000
Size (quadratic)	.000	.000	.832	.4057
Shade	.501	.057	8.775	.0000
Vegetation	.087	.056	1.553	.1204
Adjusted McFadden's Rho ²	.737			

Table 10. Preferences for Beach Characteristics: Commercial Patrons' Lunch

Multinomial Logit Estimations	Parameter Estimate	SE of Parameter	t	p
Intercept	1.730	.135	12.815	.0000
Size (linear)	.013	.004	3.049	.0023
Size (quadratic)	-.001	.000	-1.497	.1345
Shade	.346	.045	7.622	.0000
Vegetation	.133	.045	2.942	.0033
Adjusted McFadden's Rho ²	.713			

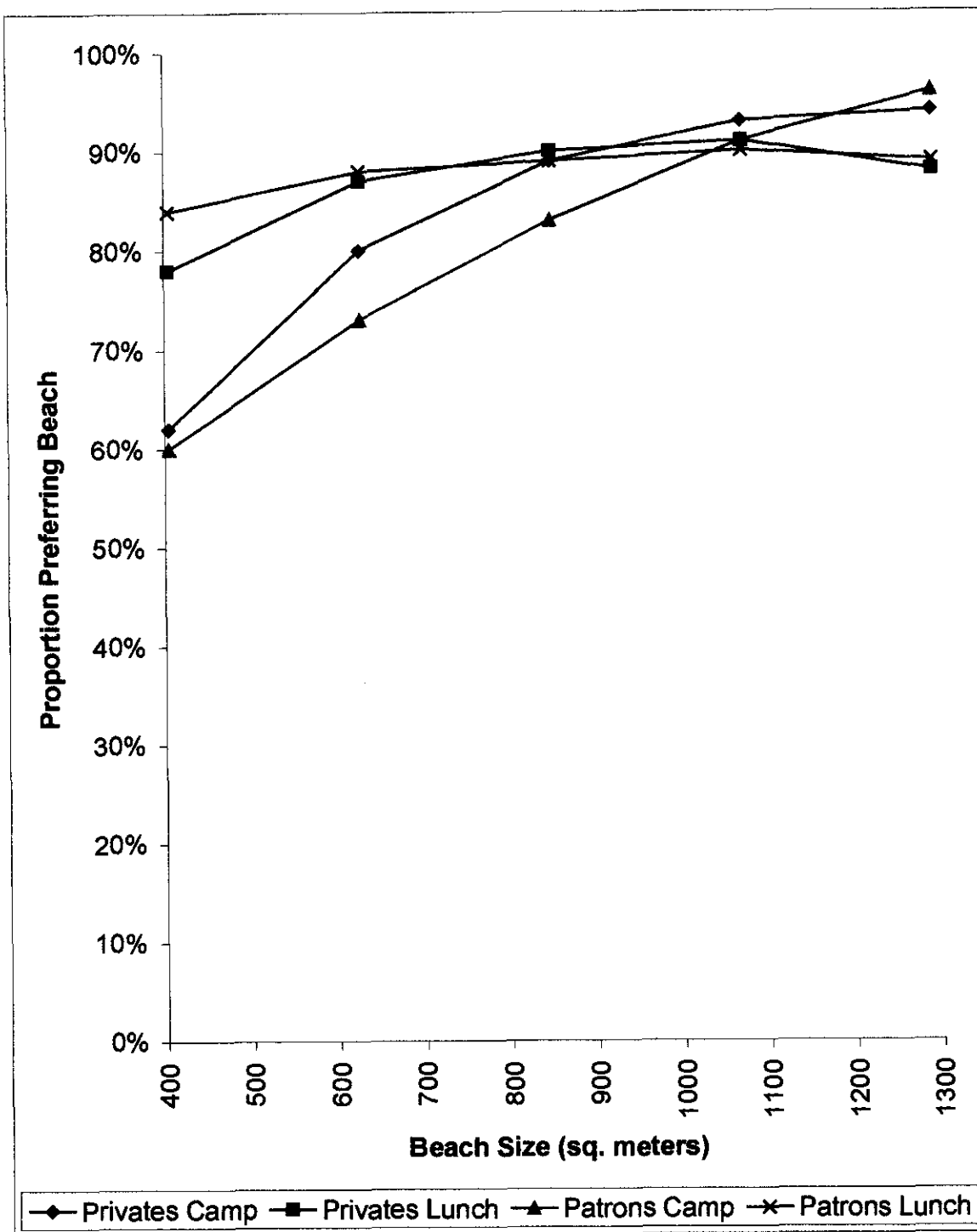


Figure 2. Commercial Patrons' and Private Trip Leaders' Preferences for Beach Size
(Assuming no shade and no vegetation)

The item on both questionnaires immediately following the beach photographs was an open-ended question prompting respondents to identify their preferred beach characteristics. As depicted in Table 11, the largest proportion of respondents indicated shade and large beaches as being the most important attributes of beaches. Other characteristics, not assessed by the photographic images included: nearby side canyons, day-hiking opportunities, location on the river, weather, season, and good eddies to moor boats easily.

Table 11. Preferred Beach Characteristics: Patrons and Privates

Preferred Attribute	Proportion of Respondents	
	Private Trip Leaders	Commercial Patrons
Shade	46%	47%
Large beach	21	35
Hiking availability	19	13
Sandy beach	13	8
Flat beach	11	12
Vegetation	11	15
Privacy	9	14
Good eddies	9	0
Side canyons	8	13

Survey of River Guides

For the sample of river guides, the National Park Service list of certified river guides was used as a basis for sampling. River guides are required to pass an in-person certification exam; the certification expires after three years, at which time the exam can be re-taken. The 1998 NPS list of river guides contained 609 names and addresses of individuals. After deleting duplicate names and insuring just one name per address, the list was reduced to 344 names and addresses. Of these, 252 names were randomly sampled, 42 names had undeliverable addresses, 4 individuals refused to participate, and 136 completed questionnaires were returned, resulting in a response rate of 65% (Table 12). See Appendix C for a copy of the guides questionnaire with frequency distributions of their responses.

Table 12. Commercial Guide Response Rates

Commercial Guides	
Completed questionnaires	136
Undeliverable addresses	42
Refused to participate	4
Total questionnaires mailed	252
Adjusted Response Rate*	65%

* Adjusted response rate was arrived at by dividing the number of completed questionnaires into the total questionnaires mailed, less the number of questionnaires returned with undeliverable addresses. Those who refused to participate are considered non-respondents in the calculations.

Relative Importance of Setting Attributes

To provide a context to understand the effects of flow-related attributes on recreation opportunities, assessing the relative importance of various setting attributes for guides was useful. Like the questionnaire of the private trip leaders and commercial patrons, the guides questionnaire contained a set of items that asked respondents to indicate the importance of various setting attributes. Some of the highest ranked items were flow-related, such as stopping at side canyons and hiking opportunities; however, some of the lowest ranked items also were flow related, particularly camping at beaches with large boulders or without low growing shrubs (Table 13).

Table 13. Guides' Importance Ratings of Trip Attributes for Rafting

Attribute	Overall Ratings*	
	Motorized Guides	Oar Guides
Relaxing, getting away from it all	2.7	2.8
Observing flora, fauna, and geology	2.9	2.9
Being on the Colorado River	2.8	2.9
Learning about the history of the Grand Canyon	2.7	2.7
Seeing wildlife	2.6	2.7
Being with family and friends	2.3	2.5
Photographing the Grand Canyon	2.1	2.1
Seeing few people while floating	1.9	2.4
Floating on quiet stretches of river	2.4	2.7
Camping at sites without evidence of soil and vegetation damage	2.3	2.2
Visiting archaeological sites	2.5	2.6
Feeling safe	2.8	2.5
Eating good food	2.1	2.2
Interacting with others on my trip	2.6	2.6
Finding a spot for lunch with a shade tree	2.2	2.3
Places along the river without trash or litter	3.0	3.0
Fishing in the Grand Canyon	1.4	1.6
Flow-related items:		
Stopping at side canyons or creeks	3.0	2.9
Hiking in the side canyons	2.8	2.9
Large rapids	2.3	2.3
Large beaches for camping	2.1	2.1
Seeing few people at attraction sites	2.1	2.4
Camping on beaches with large boulders	1.3	1.3
Being the only group camping at a beach	2.6	2.7
Beaches without low growing shrubs	1.4	1.5

* Overall ratings are based on a scale of 1= not important to 3= very important.

Guides also were asked about the effect of the 1996 spike flow on recreational opportunities in the Colorado River corridor. Respondents were asked if they made any raft trips in the summer of 1996, and if “yes”, five items assessed their attitudes regarding the relationships between the effects of the spike flow and river rafting experiences. By reporting their level of agreement with several statements (Table 14), two-thirds or more of the sampled river guides indicated that the 1996 spike flow “improved beaches for recreational use”, that “spike flow releases are generally good for recreational use”, and that “improving the quality of recreational river running should be an important factor in the management of release flows from Glen Canyon Dam.”

Table 14. Respondents’ Attitudes Toward “Spike Flows” from Glen Canyon Dam

	Proportion of Respondents (N= 116)					Mean*
	Strongly Agree		Neutral		Strongly Disagree	
The 1996 “spike flow” from Glen Canyon Dam improved beaches for recreational use.	42%	36%	13%	8%	2%	1.9
Beach development that resulted from the 1996 “spike flow” did not improve the recreational experience.	9	11	20	41	19	3.5
The “spike flow” did not have any effect on recreational use during the summer of 1996.	7	9	19	40	25	3.7
Spike flow releases from Glen Canyon Dam are generally good for recreational use.	29	35	22	10	3	2.2
The impacts to recreational use should not be a consideration in the management of release flows from Glen Canyon Dam.	9	7	8	22	54	4.0
Improving the quality of recreational river running should be an important factor in the management of release flows from Glen Canyon Dam.	44	29	11	7	9	2.1

* Mean values are based on a scale of 1= strongly agree to 5= strongly disagree

Perceptions of Flow Levels

River guides were asked to evaluate their satisfaction with constant flow levels between 2,000 and 80,000 cfs on a 5-point scale ranging from “very satisfactory” to “very unsatisfactory.” Responses were nearly identical to the responses from Bishop et al. (1987) and reflected bell-shaped curves as shown in Figures 3 and 4 for commercial oar and motor guides, respectively. Below 5,000 cfs responses were very unsatisfactory. Above 10,000 cfs and below 50,000 cfs, responses were above the midpoint of the satisfaction scale and considered as satisfactory or very satisfactory constant flows. Peak levels of satisfaction ratings, across both studies and types of guides, occurred between 20,000 and 25,000 cfs.

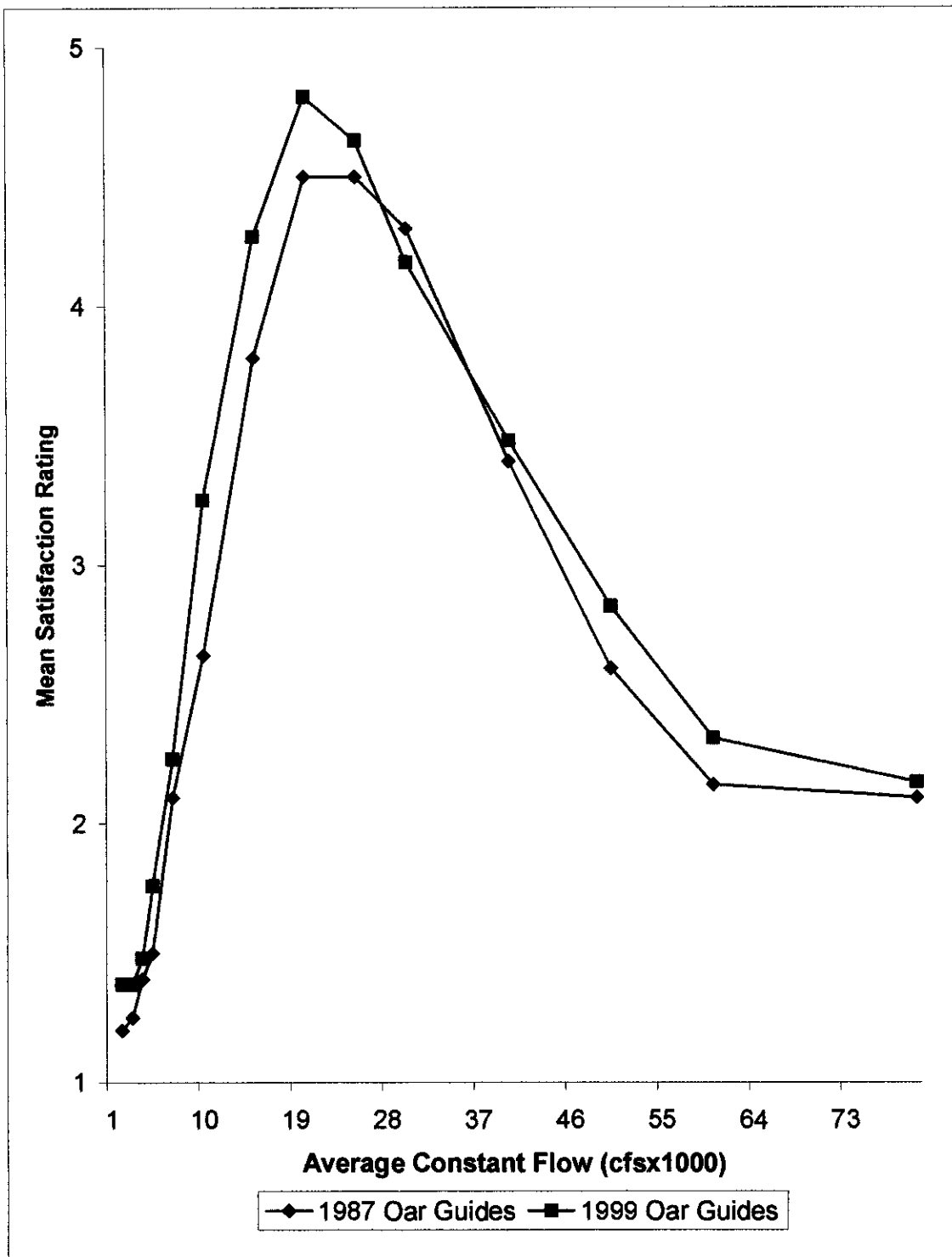


Figure 3. Oar Guides' Satisfaction at Constant Flows

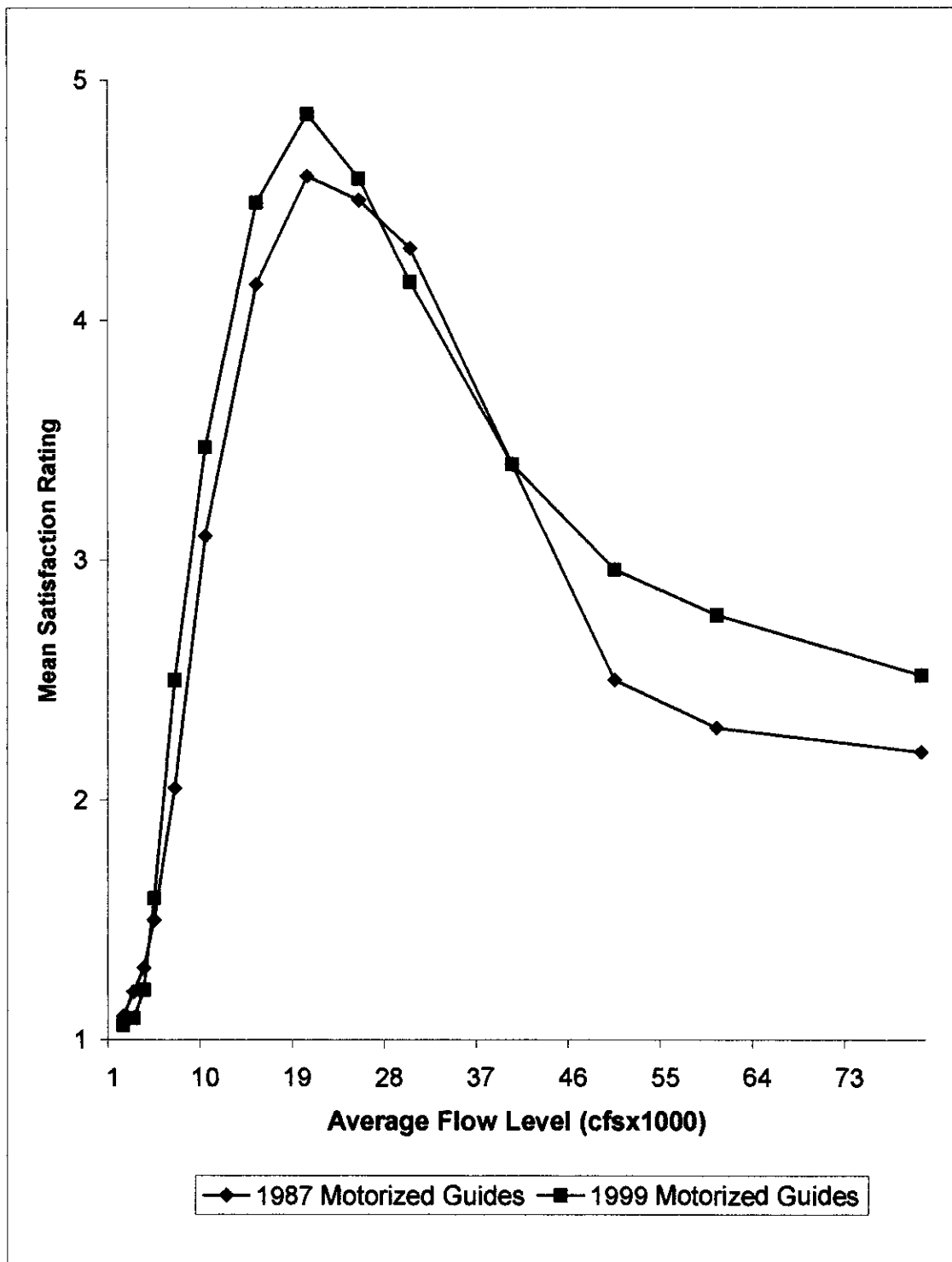


Figure 4. Motor Guides' Satisfaction at Constant Flows

Respondents also were asked to state the level of constant flow that they prefer most. Table 15 indicates that the mean of preferred flows for both commercial oar and motor guides was near 20,000 cfs, whereas Bishop et al. (1987) reported the mean of preferred flows for commercial oar guides was near 20,000 cfs but motor guides was near 26,000 cfs.

Table 15. Guides' Preferred Constant Flow Levels

Flow	Commercial Oar Guides		Commercial Motor Guides	
	1987	1999	1987	1999
Preferred flow				
Mean	26,180 cfs	20,113 cfs	20,622 cfs	20,074 cfs
Standard Deviation	10,583	5,819	6,096	6,030
Sample Size	50	62	78	54

Respondents were asked for the minimum flow level for running the river safely with passengers. Table 16 indicates that mean reported flow levels were slightly lower by about 1,000 cfs than in Bishop et al. (1987) for both oar and motor guides. Another item asked for the maximum flow level for running safely with a group. Table 17 indicates that mean reported flow levels were lower for both oar and motor guides by about 9,000 cfs compared to that reported by Bishop et al. (1987).

Table 16. Guides' Minimum Constant Flow Level for a Safe Trip

Flow	Commercial Oar Guides		Commercial Motor Guides	
	1987	1999	1987	1999
Minimum flow				
Mean	9,198 cfs	8,162 cfs	8,405 cfs	7,850 cfs
Standard Deviation	4,859	3,497	3,344	3,112
Sample Size	52	65	78	57
Percent with minimum level of 3,000 cfs or above	88	92	100	100
Percent with maximum level of 10,000 cfs or above	52	42	42	33

Table 17. Guides' Maximum Constant Flow Level for a Safe Trip

Flow	Commercial Oar Guides		Commercial Motor Guides	
	1987	1999	1987	1999
Maximum flow				
Mean	54,910 cfs	45,881 cfs	59,014 cfs	51,250 cfs
Standard Deviation	23,635	23,462	25,292	29,078
Sample Size	50	59	69	44
Percent with maximum level of 30,000 cfs or less	12	32	9	34
Percent with maximum level of 40,000 cfs or less	32	51	20	52

Like the Bishop et al. study, a set of items asked questions about actions taken at various flow levels (Table 18). Actions generally were reported at low and high flows, and the curves depicted in Figures 5, 6, and 7 are generally U-shaped. For example, the proportion of guides who reported running their motors or rowing more or less than usual to compensate for the river current was high for constant flows either below 10-15,000 cfs or above 25-30,000 cfs (Figure 5). In addition, Figure 6 indicates that at most flow levels guides were stopping less to scout major rapids in 1999 compared to 1987; difference may be due to the lack of fluctuating flows in 1999 which provided more certainty about the characteristics of rapids.

Table 18. Actions Taken at Various Constant Flow Levels

	Proportion Citing Each Action at Each Constant Flow Level (cfs x 1000)															
	1000-5000cfs		5000-1000 cfs		10000-15000 cfs		15000-20000 cfs		20000-25000 cfs		25000-35000 cfs		35000-50000 cfs		50000+ cfs	
	Oar	Motor	Oar	Motor	Oar	Motor	Oar	Motor	Oar	Motor	Oar	Motor	Oar	Motor	Oar	Motor
Stop at major rapids, such as Houserock, Hance, Crystal or Lava to scout	85%	88%	88%	81%	73%	23%	67%	12%	70%	11%	79%	30%	82%	61%	82%	75%
Stop at any other rapids to scout	67	79	58	58	9	12	6	7	6	5	22	12	43	37	48	46
Row or motor more than usual to make up time	84	90	87	84	39	14	6	4	5	2	3	0	3	0	3	0
Row less than usual or turn off motor because you are ahead of schedule	2	2	2	2	5	2	18	9	46	28	76	60	79	79	76	84
Hurry to get out of camp in the morning	72	70	82	65	45	33	10	19	5	14	3	14	3	11	3	11
Have trip members walk around a rapid because the water is too low	70	67	42	23	3	4	0	0	0	0	0	0	3	0	3	0
Have trip members walk around a rapid because the water is too high	2	2	0	2	0	2	0	2	3	2	16	2	51	16	73	33

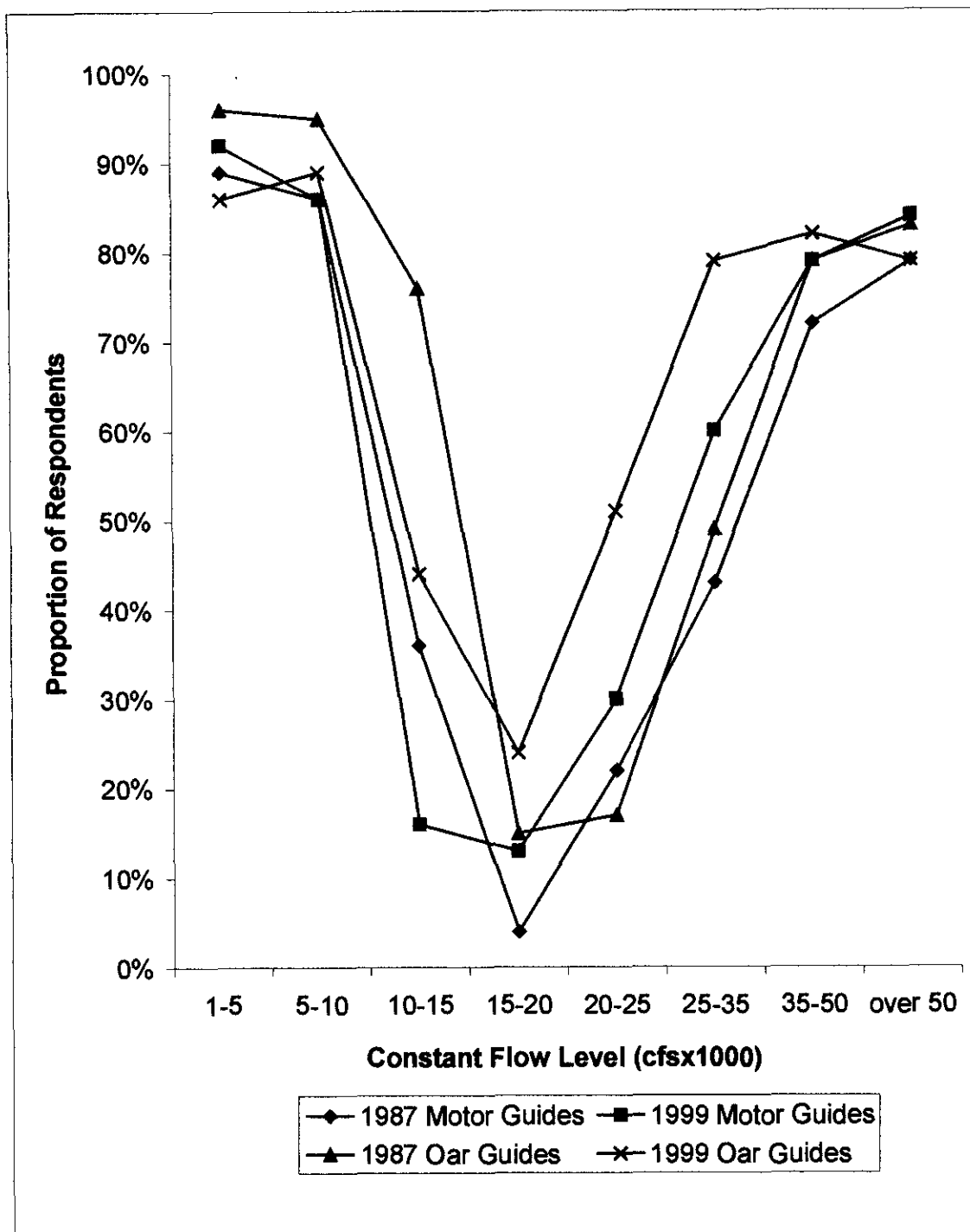


Figure 5. Guides Who Run Motor or Row More or Less to Compensate for the River Current at Constant Flows

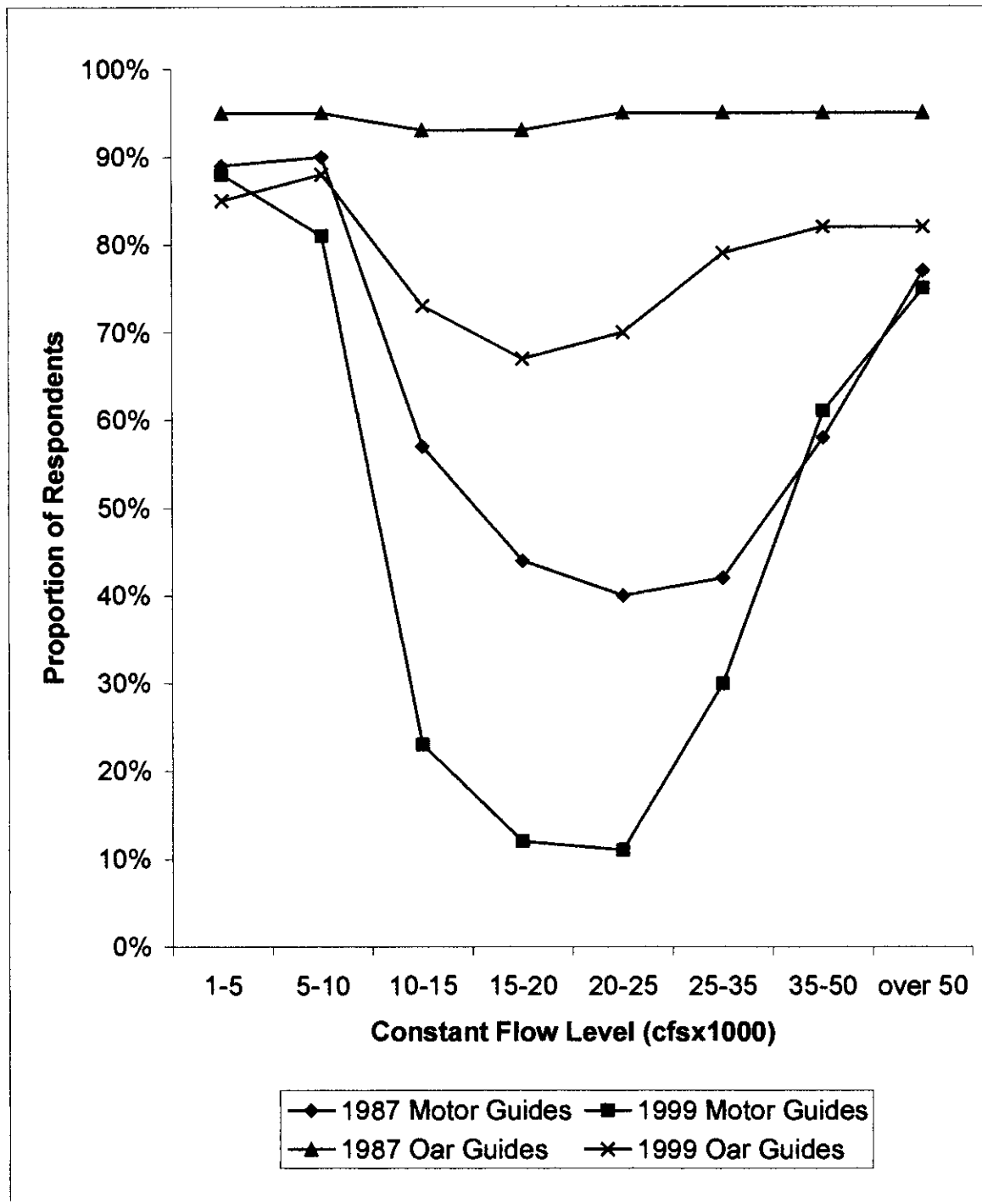


Figure 6. Guides Stopping to Scout Major Rapids at Constant Flows

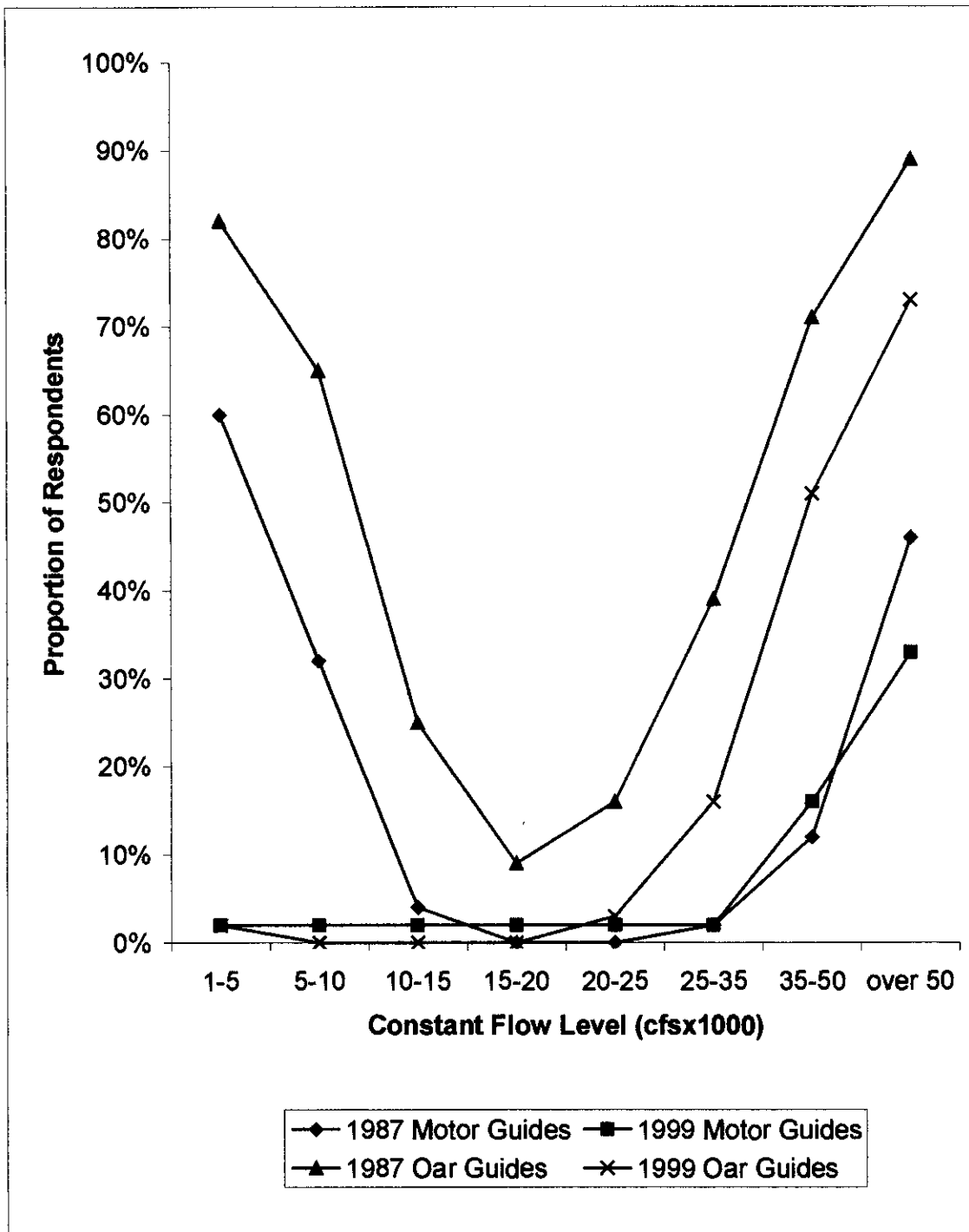


Figure 7. Guides Who Have Passengers Walk Around Rapids at Constant Flows

Preferences for Beach Characteristics

Multinomial logit choice models for river guides were estimated in the same way as for commercial patrons and private trip leaders. Model coefficients, standard errors and *t* tests are presented in Tables 19 and 20. Figure 8 contains plots of the choice functions versus size for both camping and lunch sites. The quadratic size coefficients are negative and statistically significant (concave downward). From Figure 8 we observe the optimal size for lunch site is about 850 square meters, and about 1,100 square meters for a camp site. Presence of shade has a significant positive utility for both lunch and camp sites. Vegetation has a negative utility for camp sites, and for lunch site it is non-significant.

Compared to the preferences of the commercial patrons and private trip leaders, the sampled river guides were more critical with their preferences for beaches. Compare the *lower intercepts* from Tables 19 and 20 with the intercepts from Tables 7 through 10, which indicate that guides were the most likely to check “neither” beach is acceptable (and pass by both of the beaches that were presented in a pair of photographs).

Table 19. Preferences for Beach Characteristics: Guides’ Camping Decisions

Multinomial Logit Estimations	Parameter Estimate	SE of Parameter	t	p
Intercept	.645	.109	5.946	.0000
Size (linear)	.084	.007	11.889	.0000
Size (quadratic)	-.003	.000	-5.346	.0000
Shade	.428	.063	6.778	.0000
Vegetation	-.285	.063	-4.550	.0000
Adjusted McFadden’s Rho ²				
	.587			

Table 20. Preferences for Beach Characteristics: Guides’ Lunch Decisions

Multinomial Logit Estimations	Parameter Estimate	SE of Parameter	t	p
Intercept	.462	.104	4.428	.0000
Size (linear)	.041	.006	7.111	.0000
Size (quadratic)	-.003	.000	-6.322	.0000
Shade	.325	.059	5.512	.0000
Vegetation	.004	.057	.071	.9430
Adjusted McFadden’s Rho ²				
	.375			

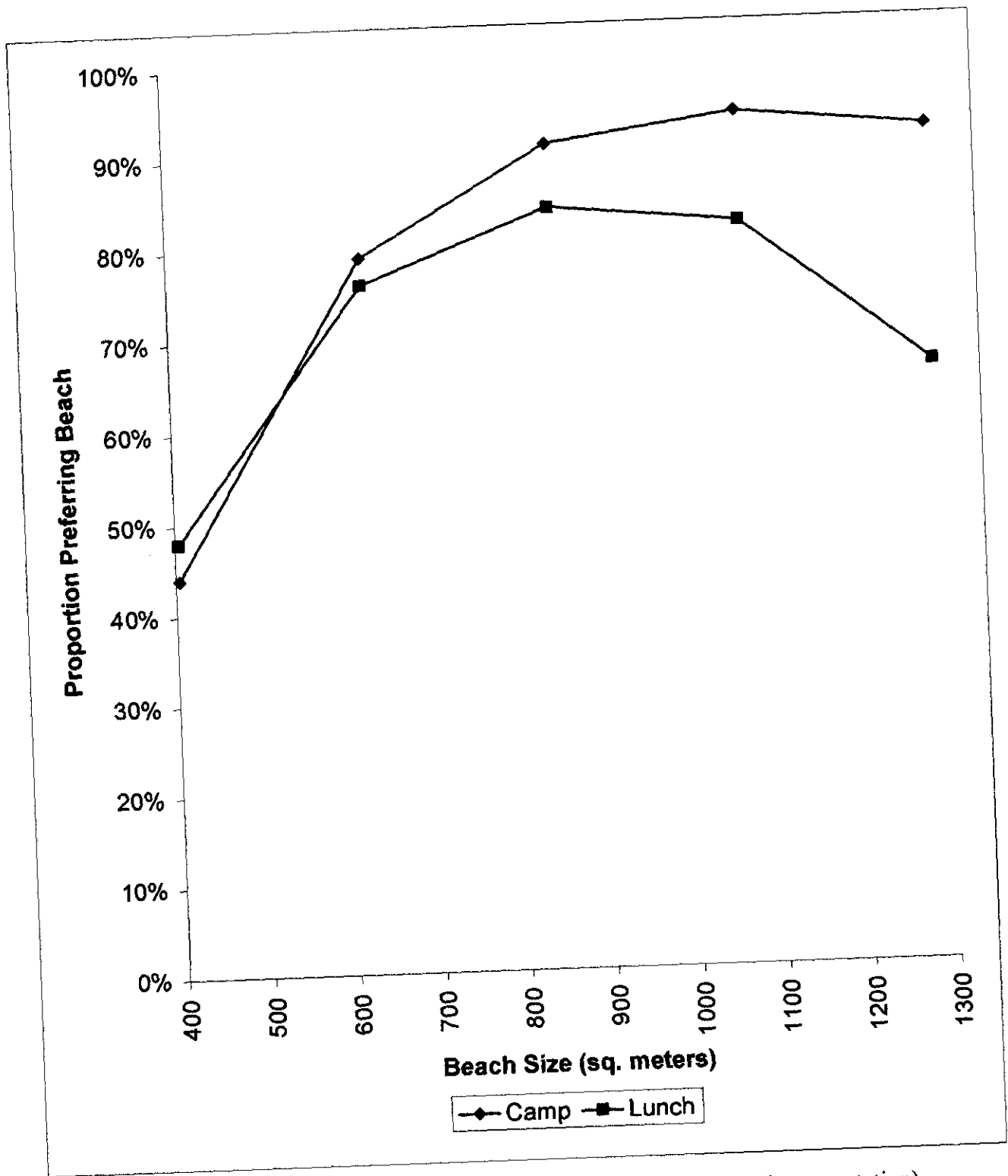


Figure 8. Guides' Preferences for Beach Size (Assuming no shade and no vegetation)

As with the MNL analyses for private trip leaders and commercial patrons, additional MNL analyses were conducted which segmented respondents and were based upon number of past rafting trips, number of years as a guide, and whether oar or motor was their typical raft type. In general, the segmentation variables were not significant nor were their interactions with the three primary variables. In other words, regardless of the level of experience in rafting, their years as a guide, or whether oar or motorized rafts, the guides responding to this study were similar to each other in their preferences for beach characteristics.

The item on the questionnaire immediately following the beach photographs was an open-ended question prompting for further information about their preferences for beach characteristics. The responses are similar to those of the patrons and privates. As depicted in Table 21, the largest proportion of respondents indicated shade and beach size were the most important attributes of beaches. The source of shade, if indicated, usually was trees or other vegetation, but some respondents also reported shade from the shadow of canyon walls. Other characteristics, not assessed by the photographic images included: day-hiking opportunities, location on the river, privacy, weather, and season. Although many of the guides' responses stated that they recognized the beaches (and thus knew contextual information about the beach and its location), guides preferences for a large size beach and shade were highly consistent.

Table 21. Preferred Beach Characteristics: Guides

Preferred Attribute	Proportion of Respondents
Shade	58%
Large beach	14
Flat beach	11
Vegetation	11
Hiking availability	10
Wind protection	9
Privacy	8

Survey of Anglers

The visitor use counts from Glen Canyon National Recreation Area indicate that 21,900 anglers fished in and around Lee's Ferry during 1998. About three-fourths of these anglers brought boats with them. The character of fishing activity has changed markedly since 1985. Catch regulations are now more restrictive; during the sampling for this study there was a bait restriction of only flies, lures, and artificial bait (i.e., rubber worms) permitted, with no live bait, salmon eggs, power bait, or added scents. Also, as a "slot limit," fish between 16 and 22 inches could not be kept.

Since there was not an inclusive list of anglers at Lee's Ferry, an interviewer was trained to sample anglers, invite them to participate in the study, and conduct a brief on-site interview. Anglers were sampled between August and November 1998 on 28 selected weekend and weekdays. Anglers were sampled using a systematic random selection process in which every n^{th} angler (on sampling days) was contacted and invited to participate. Sampling days were selected to be distributed evenly over the sampling period and to be approximately half weekday and half weekend days. About three-fourths of the anglers were contacted while putting-in or taking-out a boat at the ramp; the remainder were interviewed on the bank trails around Lee's Ferry. During the time period of sampling, average daily flows ranged between 11,000 to 21,000 cfs; and about 6,200 anglers fished from Lee's Ferry which is about 28% of the year's total.

Of the 395 anglers who were sampled, 12 refused to participate and 52 were repeat anglers (who were sampled twice at different times). From the remaining 331, there were 295 names randomly selected and mailed questionnaires. Of these, 8 had undeliverable addresses, 4 wrote back refusing to participate, and 238 completed and returned their questionnaires, resulting in a response rate of 83% (Table 22). See Appendix D for a copy of the anglers questionnaire with frequency distribution of their responses.

Table 22. Lee's Ferry Angler Response Rates

	Anglers
Completed questionnaires	238
Undeliverable addresses	8
Refused to participate	4
Total questionnaires mailed	295
Adjusted Response Rate*	83%

* Adjusted response rate was arrived at by dividing the number of completed questionnaires into the total questionnaires mailed, less the number of questionnaires returned with undeliverable addresses. Those who refused to participate are considered non-respondents in the calculations

Relative Importance of Setting Attributes

Relative importance of setting attributes was assessed by asking anglers to rate the importance level of several attributes that contribute to an “excellent or perfect fishing trip at Lee’s Ferry for you,” and then again, by asking them to rate the importance level of several attributes that contribute to “a poor fishing trip.” Compared to the results found by Bishop et al. (1987) for attributes related to perfect trips, anglers in this study reported a decrease in the importance of catching a trophy fish and in catching their limit, and reported an increase in seeing few other people (Table 23). In addition, the attributes with the highest ranking of importance were not assessed by Bishop et al. (1987) and are related to fish health: catching healthy looking fish and catching fish that have a lot of energy.

Table 23. Attributes of a Perfect Glen Canyon Fishing Trip

Attribute	Proportion of Respondents Stating Attribute is Important*							
	All Anglers		More than Two Years Experience		Experience with Fluctuating Flows		Boat Anglers	
	1987	1999	1987	1999	1987	1999	1987	1999
Good weather	84%	79%	80%	77%	80%	77%	84%	81%
Catching a trophy fish	79	66	79	71	85	70	83	71
Catching your limit	68	45	59	51	64	42	68	64
Seeing few others	67	83	66	85	76	84	70	87
Low water	60	67	66	69	70	70	59	55
High water	54	55	54	56	59	54	54	58
Falling water level	52	55	55	54	59	57	47	60
Rising water level	51	64	56	68	54	66	49	67
Camping along the river	26	32	27	40	34	32	27	37
Catching a lot of fish	n/a	83	n/a	85	n/a	83	n/a	85
Catching a healthy-looking fish	n/a	99	n/a	99	n/a	99	n/a	97
Catching fish that have a lot of energy	n/a	98	n/a	99	n/a	99	n/a	95

*These percentages are derived from respondents’ answers to questions asking whether the reason is very, somewhat, or not important. Percentages reported here record the proportion of respondents saying the reason is somewhat or very important.

Compared to the results found by Bishop et al. (1987) for attributes related to a poor fishing trip, anglers in this study reported that the importance of “not catching your limit,” “not catching a trophy fish,” and “low water” decreased from the 1987 results. In addition, “not being able to get upstream,” “boat/motor trouble due to low water”, and “seeing many others” increased from the 1987 results (Table 24).

Table 24. Attributes of a Poor Glen Canyon Fishing Trip

Attribute	Proportion of Respondents Stating Attribute is Important*							
	All Anglers		More than Two Years Experience		Experience with Fluctuating Flows		Boat Anglers	
	1987	1999	1987	1999	1987	1999	1987	1999
Catching no fish	89%	92%	85%	92%	83%	92%	88%	93%
Not being able to get upstream	79	89	70	87	76	90	87	98
Poor weather	78	76	76	74	75	73	77	78
Boat/motor trouble due to low water	74	81	67	81	72	83	81	90
Seeing many others	71	87	64	88	71	91	74	92
Not catching your limit	63	45	58	48	60	46	64	61
High water	61	71	66	69	71	60	61	59
Low water	61	56	69	59	75	56	61	61
Falling water level	58	64	54	63	67	63	54	63
Rising water level	57	64	61	63	56	63	55	66
Not catching a trophy fish	57	35	53	37	56	37	59	37
Not being able to camp along the river	31	39	29	44	33	29	33	43
Not catching a lot of fish	n/a	75	n/a	73	n/a	76	n/a	80
Other anglers at my fishing spot	n/a	77	n/a	79	n/a	78	n/a	70

*These percentages are derived from respondents' answers to questions asking whether the reason is very, somewhat, or not important. Percentages reported here record the proportion of respondents saying the reason is somewhat or very important.

To explore further the type of fishing opportunities preferred by Glen Canyon anglers, respondents were asked for their level of agreement on several items related to preferences for size of fish and number of fish caught. In general, there were a diversity of opportunities preferred by anglers regarding fish size and number (Table 25). About two-thirds of respondents agreed with the statement "I was satisfied with the number of fish I caught." About one-half of respondents agreed with the statement "I was satisfied with the size of the fish I caught." About one-fifth disagreed with the statement "I would rather catch one or two big fish than ten smaller fish."

Table 25. Anglers' Agreement with Type of Fishing Opportunity

Statement	Level of Agreement				
	Strongly Agree				Strongly Disagree
I was satisfied with the number of fish I caught	39%	26%	23%	7%	4%
I was satisfied with the size of the fish I caught	19	32	31	12	6
Most of the fish I caught from the Colorado River were about the same size	16	39	28	11	5
Almost all of my fishing in the Colorado River is catch-and-release	77	9	6	3	5
The more I catch, the happier I am	33	27	24	12	5
A successful trip is one in which many fish are caught	22	22	36	14	6
I would rather catch a large number of medium-sized fish than a small number of large-sized fish	6	23	37	25	9
I would rather catch one or two big fish than ten smaller fish	18	27	33	19	4
I was bothered by catching too many smaller-sized fish	5	10	19	31	35

In a question that asked respondents for their reasons for fishing at Lee's Ferry, close to 90% reported they thought they would catch a large fish (Table 26), which is a slight increase compared to the findings of Bishop et al. (1987). Responses to all the items in this question indicated that anglers rated each reason as more important compared to the ratings of the Bishop et al. (1987) study. Thus, in 1999 compared to 1987, more anglers wanted to catch large fish, lots of fish, stay close to home, and perceived a scarcity of other trout fishing areas.

Table 26. Reasons for Fishing in Glen Canyon

Reason	Proportion of Respondents Stating Reason is Important*							
	All Anglers		More than Two Years Experience		Experience with Fluctuating Flows		Boat Anglers	
	1987	1999	1987	1999	1987	1999	1987	1999
Thought I would catch a large fish	86%	88%	82%	91%	84%	90%	88%	85%
Thought I would catch a lot of fish	75	85	73	85	75	84	77	82
Wanted to fish in Glen Canyon	57	86	50	87	51	87	65	84
Few other trout fishing areas available	41	61	37	71	40	64	45	51
Close to home	33	50	39	64	42	56	28	35
Wanted to catch a trophy fish	n/a	52	n/a	61	n/a	59	n/a	53

*These percentages are derived from respondents' answers to questions asking whether the reason is very, somewhat, or not important. Percentages reported here record the proportion of respondents saying the reason is somewhat or very important.

Perceptions of Flow Levels

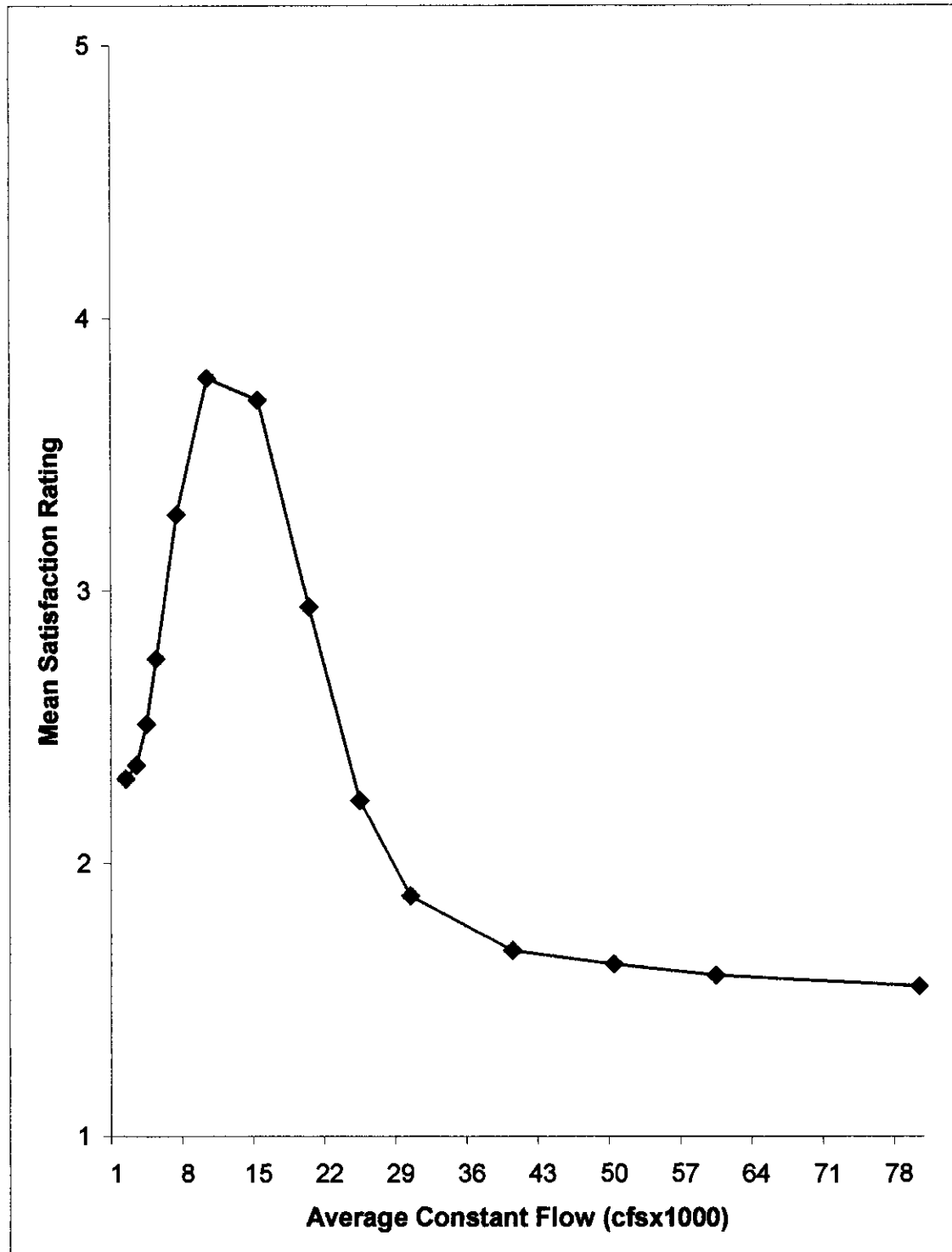
To understand the level of past fishing experience at specified flow levels, respondents were asked if they ever fished at Lee's Ferry under various river flow conditions. Table 27 indicates that 1999 respondents were much more experienced than their counterparts from 1987. For example, in 1987 54% of respondents reported past experience with fluctuating flows, whereas in 1999 78% of respondents reported such experience.

Table 27. Angler Fishing Experience at Specified Flow Levels

Responses	Proportion Reporting Experience with Flow							
	High Flow (Greater than 16,000 cfs)		Medium Flow (9,000- 16,000 cfs)		Low Flow (Less than 9,000 cfs)		Fluctuating Flow	
	1987	1999	1987	1999	1987	1999	1987	1999
Yes, Experienced	n/a	58%	44%	70%	38%	58%	54%	78%
No, Did Not Experience	n/a	11	20	4	27	13	16	5
Don't Know	n/a	32	36	26	35	29	30	17

Anglers were asked to evaluate their satisfaction with constant flow levels between 2,000 and 80,000 cfs on a 5-point scale ranging from "very satisfactory" to "very unsatisfactory." Responses reflected a bell-shaped curve as shown in Figure 9 with the peak of the bell at a lower range of flows compared to the satisfaction reports of rafters. Below 5,000 cfs responses were very unsatisfactory. Above 7,500 cfs and below 20,000 cfs, responses were above the neutral line and considered as satisfactory or very satisfactory constant flows. Peak levels of satisfaction ratings for anglers occurred between 10,000 and 15,000 cfs.

Figure 9. Angler Satisfaction at Constant Flows



Survey of Day-Trip Rafter

Glen Canyon National Recreation Area reports that 61,600 visitors took a day or half-day trip from the Dam to Lee's Ferry during 1998. These rafters, who were sampled in November 1998 and March/April 1999, experienced average daily flows ranging between 10,000 to 14,000 cfs.

On the 15 sample days (of which most were weekdays), day-trip rafters were contacted as they walked from the Lee's Ferry boat dock to a parked tour bus (which gave them a return trip to Page, Arizona). A interviewer was trained to sample day-trip rafters, invite them to participate in the study, and if willing, visitors were invited to provide their name and address in order to receive a mailback questionnaire. There were 22 day-trip rafters contacted in November, and 144 contacted in March and April. There were not any day-trip rafters who refused the invitation to participate; however there were 15 visitors contacted who had non-U.S. addresses and were dropped from the sample. There were 47 visitors with duplicate addresses (i.e., most likely a husband and wife couple) who were dropped from the sample. Of the final set of 166 sampled day-trip rafters, 5 names had undeliverable addresses, and 132 completed questionnaires were returned, resulting in a response rate of 82% (Table 28). See Appendix E for a copy of the day-trip rafter questionnaire with frequency distributions of their responses.

Table 28. Day-Trip Rafter Response Rates

	Day Trip Rafter
Completed questionnaires	132
Undeliverable addresses	5
Total questionnaires mailed	166
Adjusted Response Rate*	82%

* Adjusted response rate was arrived at by dividing the number of completed questionnaires into the total questionnaires mailed, less the number of questionnaires returned with undeliverable addresses.

Relative Importance of Setting Attributes

To provide a context to understand the effects of flow-related attributes on recreation opportunities, assessing the relative importance of various setting attributes for day-trip rafters was useful. The day-trip rafter questionnaire contained a set of items that asked respondents to indicate the importance of various setting attributes. The items ranked highest in importance were being in a natural setting, learning about the Canyon's history, good weather, having confidence in the guide, and being on the river (Table 29).

Table 29. Importance Ratings of Attributes for Day Trip Rafters

Attribute	Overall Ratings*
Being in a natural setting	3.0
Being on the Colorado River	2.8
Learning about the history of the Grand Canyon	2.8
Well-paced and organized trip	2.8
Good weather	2.8
Having confidence in my guide or trip leader	2.8
Floating on quiet stretches of river	2.7
Visiting archaeological sites	2.7
Feeling safe	2.7
Seeing wildlife	2.6
Being with family and friends	2.6
Interacting with my guide	2.6
Stopping to explore along the river	2.6
Relaxing, getting away from it all	2.5
Learning about the Glen Canyon Dam	2.4
Seeing the Canyon in one day	2.3
Seeing few people while floating	2.2
Starting the trip at the dam	2.2
Not having to make advance plans for the trip	2.2
Stopping for lunch along the river	1.9
Learning about others on the trip	1.5

* Overall ratings are based on a scale of 1= not important to 3= very important.

Perceptions of Flow Levels

The sampled day-trip rafters were asked if they knew the expected river water level on the date of their trip. More than 90% reported that they did not know it (Table 30), which is almost the same proportion reporting such in Bishop et al. (1987). Respondents also were asked about their preferences for river flow level. More than half of respondents indicated that they did not have a preference (Table 31), which is a similar proportion to the findings reported by Bishop et al. (1987). Sampled day-trip rafters also were asked if they knew the water temperature before arriving at the river, and if their trip would have been more enjoyable if the "river water were warmer." About one-third of respondents reported knowing the river water temperature, and just 11% indicated preferences for warmer water (Table 32).

Table 30. Day-Trip Rafters' Knowledge of Water Level

Response	Proportion Who Knew the Water Level	
	1987	1999
Did not know the expected water level	94%	92%
Knew expected water level		
• influenced decision to take raft trip	0	2
• did not influence decision to take raft trip	6	6

Table 31. Day-Trip Rafters' Preferred Water Level

Response	Proportion Checking Response Category	
	1987	1999
Preferred lower water	3%	1%
Preferred current level	28	37
Preferred higher water	13	9
Don't know or doesn't matter	56	53

Table 32. Day-Trip Rafters' Preferences for Water Temperature

Response	Proportion Who Agreed With Each Statement
Knew the expected water temperature	32%
Trip would have been more enjoyable if the water were warmer	11

CONCLUSIONS

This study assessed preferences of five recreational user groups of the Colorado River in Grand Canyon. The assessments primarily targeted the relative importance of flow-related setting attributes, perceptions of river flow, and preferences for beach characteristics. The two phases of this research allowed the user surveys of phase 2 to be partially grounded in the stakeholder issues emerging from phase 1. In addition, user preferences were assessed to compare with those found by Bishop et al. (1987). The conclusions, which are based upon the stakeholder and user assessments, follow directly from the major objectives (p. 6) of this study.

The principal conclusions from this study are the following:

1. *Glen Canyon Dam releases have substantial impacts on recreational opportunities in the river corridor.* Private trip leaders, commercial patrons, river guides, and anglers all reported preferences for various flow-related setting characteristics. For private trip leaders and commercial patrons, time at attraction sites, lack of crowding at attraction and camp sites, and large and long rapids contributed to a high quality recreational trip. Sampled private trip leaders reported an ideal constant flow of about 23,000 cfs. River guides reported that having time to stop at attraction site, hike in side canyons, and being the only group at a camping beach contributed to a high quality recreation. Sampled river guides reported an ideal constant flow of about 20,000 cfs. For anglers, being able to fish without being crowded, and habitat that produces healthy and vigorous fish contributed to a high quality trip. Sampled anglers reported an ideal constant flow of about 10,000 cfs. Day-trip rafters are probably the least sensitive to flow-related characteristics due to the short-term nature of their trip and their lack of knowledge about flow-related issues.

2. *The negative effects of fluctuating flows on recreational use were not substantial problems during the time period of this study.* Results from stakeholder discussions of phase 1, which included dialogue with a diversity of river recreationists, concluded that fluctuating flow problems have been effectively addressed by the ROD (1996), and thus, fluctuating flows were not a high priority issue. In addition, the final open-ended item on the questionnaires asked respondents if they had any comments about recreation on the Colorado River; although the sampled users commented on most topics (see Appendices A through E), comments related to fluctuating flows were scarce. Compared to the Bishop et al. (1987) study in which fluctuating flows were found to be a major source of negative impacts from Glen Canyon Dam operations, this study indicated that such problems have been greatly reduced. However, while fluctuating flows are not currently a problem, the effects of flow regimes based on the ROD (1996) after a period of low run-off years is unknown.

3. *The recreational impacts of constant flow releases from Glen Canyon Dam were remarkably unchanged since the Bishop et al. (1987) study.* Attitudes and preferences regarding

constant flows have not changed significantly in the past 15 years or so. Across the five user groups, several trip attributes exhibited similar levels of importance between this study and Bishop et al. (1987). For examples, private trip leaders and commercial patrons ranked stopping and hiking at side canyons as highly important to their raft trip across both studies. The satisfaction of white-water rafters at various constant flow levels was almost identical between the previous study and this one. Also, about two-thirds of responding anglers in both studies indicated that "low water" was important to a perfect Glen Canyon fishing trip.

There are still clear differences between rafters and anglers regarding preferences for constant flows. However differences in seasonal use patterns between rafters and anglers provides potential for Glen Canyon Dam operations to integrate their preferences. Although many of the conclusions from Bishop et al. (1987) are still relevant, one in particular addresses this point.

Flow regimes combining high constant flows in the months of May through September with moderate or low flows during the remainder of the year would be likely to produce the largest recreational benefits. (Bishop et al., 1987, p. 176)

As an important exception to the general similarity between the two study results, the guides' maximum constant flow for a safe trip was lower in this study than in the previous one; for example 32% of 1999 sampled oar guides reported a maximum safe flow of "30,000 cfs or less" whereas 12% of 1987 sampled oar guides reported the same (comparison in Table 17). It may be that sampled guides were influenced by flow levels at the time of reporting; in other words the flows of the late-1990s were lower than the flows of the mid-1980s which may have influenced guides appraisal of the maximum constant flows for a safe trip.

4. *The 1996 spike flow, as it affected beach development, was perceived as significantly improving recreational opportunities for rafters.* At least two-thirds of the sampled river guides indicated (through several different measures) that spike flows improved beaches and enhanced the quality of recreational river running. Of the responses to the last open-ended question from the private trip leader and river guide questionnaires, the effect of high-volume release flows was a frequently mentioned topic. Invariably the responses were positive about the impacts of such flows and their ability to simulate pre-dam seasonal flooding (see Appendices for a verbatim listing of open-ended responses). In addition, sharing a camp with another party of rafters was consistently reported as significantly detracting from the quality of recreation. To the extent that the impact of spike flows increase the number of useable beaches in the river corridor, the need to share a camp with another party will be minimized. In particular, competition for camping beaches in critical reaches of the river corridor was a primary source of dissatisfaction. Spike flows are being promoted as a means to achieve an increase in number and size of beaches, and hence, they have considerable support amongst the recreational public. However, there may be other strategies to increase the number and size of beaches in the critical reaches of the river corridor, and these would probably be supported by recreationists. A key

component of future GCMRC monitoring efforts would be to assess the increased number, size, and location of useable beaches due to spike flows and to identify factors affecting beach durability and persistence.

The beneficial effects of spike flows on fishing opportunities was not as apparent as the effects on rafting opportunities. The two most important attributes of a Glen Canyon fishing trip were catching "a healthy looking fish" and catching one with "a lot of energy." To the extent that spike flows enhance the health and vigor of fish, anglers also would be in support of such release flows. However, it is not clear if beach habitat building flows are the same as fish habitat building flows. Another key component of future GCMRC monitoring efforts would be to assess the relationship between spike flows and fish habitat with emphasis on the identification of factors affecting fish health and vigor.

5. *Large size beaches with shade from trees are setting characteristics with highly reliable and strong user preferences.* Across three user groups (i.e., private trip leaders, commercial patrons, and river guides) and across several segmentation variables (i.e., past experience, boat type, group size), the larger beaches were the most likely to be preferred for camp and lunch, and the beaches with shade from trees were likely to be preferred. Even though this study employed three different base images as well as allowed for other sources of external variation, the finding that users generally preferred beach campsites greater than 800 square meters that include shade from trees exhibited high consistency across the three groups of white-water boaters. In contrast, low-growing vegetation on beaches was not related to strong user preferences. Responses to open-ended questions about preferred beach characteristics also indicated strong preferences for large size beaches and shade. In addition, the size of beach was consistently ranked from a series of attributes as being moderately important by private trip leaders, commercial patrons, and guides.

6. *There is both commonality and disparity between user preferences and stakeholder directions.* The major points of overlap between user preferences and stakeholder issues were: concern over the impact of spike flows, lack of interest in fluctuating flows, and a general awareness that various characteristics related to constant flows have a significant impact on recreational use.

Points of disparity between user preferences and stakeholder issues are based on the plurality of viewpoints represented amongst stakeholders. Some stakeholders may resist the development of explicit linkages between beach habitat building flows and the enhancement of recreational quality. The context for discussion of spike flows within the Technical Work Group (TWG) is based primarily upon the physical sciences without explicit linkages to recreation user preferences or social value. Identification of linkages between recreation user preferences and dam operations provides an expanded context to evaluate decisions about release flows; an expanded context of dam operating decisions *which includes recreation user preferences* would be embraced by some stakeholders and not by others. In addition, some of the Native American

tribal concerns questioned recreational use of the river corridor altogether. What for recreational rafters is a leisure experience, for a portion of Native Americans is a sacred journey. Thus any linkages between recreational use and the Colorado River in Grand Canyon is viewed as sacrilege by some stakeholders representing Native American tribes.

As limitations on this study and as grist for future recreation research, the relative importance of various setting characteristics and their linkages to recreation quality needs further investigation. The objectives of this study were directed at understanding relationships between user preferences and flow-related characteristics. Although such objectives ostensibly target managerial relevance, they risk viewing recreational use through an artificially small window that may be unable to capture elements that fully explain high-quality recreation opportunities. As an analogy: when fisheries biologists were asked to study the effect of flows on the humpback chub, they first needed to understand the life-cycle and seasonal patterns of the chub prior to understanding the effect of flows on the chub (see Bureau of Reclamation, 1995). In an analogous fashion, without first understanding more fully the nature of river-based recreation resources and experiences, it is challenging to completely address questions related to flow releases and recreational use.

There are at least two directions for future recreation research derived from the GCMRC's mission. The first is to undertake a study that addresses basic questions about linkages between recreational experiences and resource characteristics within the river corridor. For a majority white-water rafters, the experiential quality of a Colorado River trip is powerfully influenced by travel brochures, the daily and cumulative narratives of river guides during one's trip, and social interaction with other rafters (of which most is positively appraised by recreationists). To what extent are release flows and flow-related characteristics linked to the daily experiences of recreational rafting? Rather than embed research in the framework of dam operations and release flows (as in this study), a recommendation would be to embed the research in the daily experiences of recreationists. The objective of the research would be to identify linkages between recreational experiences and release flows as they emerge in the daily experiences of rafting and fishing. Such results would provide a more comprehensive ability to explain such linkages and their relative importance to recreation quality.

A second direction for future recreation research would be to undertake a study that explicitly addresses use values (both social and economic) *within a regional context*. A user study samples only those people who chose the Colorado River as a place for recreation. However, there are numerous other places within the Colorado Plateau that were either part of recreational trips to the Colorado River (a.k.a., multi-destination trips) or were included in recreationists' "choice set" of destinations for recreation. Understanding destination decision-making for recreationists attracted to the region accounts for trade-offs between resource characteristics at various destinations, and provides a context to understand the distinction of recreational resource characteristics of the Colorado River below the Dam. In other words, the Colorado River ecosystem as a recreational resource is not insulated from its regional context.

This recommendation recognizes that any empirically-based use-valuation should account for the value of resource characteristics within a set of regional opportunities, and be inclusive of preferences for both current and potential users. An example of such research questions would be to assess the extent to which release flows and flow-related characteristics are linked to decisions to choose the Colorado River ecosystem as a place for recreation; the research context would be the decision-making frames of recreationists within the Colorado Plateau. The objective of the research would be to identify linkages between the value of Colorado River recreation and release flows as they emerge in recreationists' decision trade-offs. Such results would provide an improved ability to explain the utility of Colorado River flow-related resource characteristics to recreationists who have made decisions to recreate within the region.

To the extent that the attitudes and preferences reported by sampled recreationists reflect on-river appraisals and decisions, the results indicate that the operations of Glen Canyon Dam continue to have substantial impacts on the quality and distribution of recreational use in the Colorado River corridor.

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