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GLEN CANYON DAM RELEASES AND DOWN STREAM RECREATION: AN ANALYSIS OF USER PREFERENCES AND ECONOMIC VALUES

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GLEN CANYON DAM RELEASES AND DOWNSTREAM RECREATION: AN ANALYSIS OF USER PREFERENCES AND ECONOMIC VALUES

Recreation
of the
Glen Canyon Environmental Studies

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This study assesses the impact of Glen Canyon Dam releases on rafting (white-water boating and day-use rafters) an angling recreationists in Glen Canyon and Grand Canyon National Park using attribute and contingent valuation surveys. Several sources of information were utilized in this study: knowledgeable people (fishing guides, rafting guides, resource managers, and GCES researchers), seven formal survys (including attribute surveys), and contingent valuation survey to quantify, in dollars, the effects of dam releases on the recreational experience. The goal of the study was to assess the impact of alternative annual flow release patterns for Glen Canyon Dam on recreationists in the aggregate. Flow regimes combining high constant flows in the summer months with moderate or low flows during the remainder of the year would be likely to produce the largest recreational benefits. Extreme high or low flows will adversely affect all river recreation, with flows below approximately 5,000 cubic feet per second and above 35,000 cubic feet per second to both boaters and anglers.

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ABSTRACT

The research reported here is part of the Glen Canyon Environmental Studies (GCES), a series of studies examining the downstream effects of alternative Glen Canyon Dam releases on the environments of Glen Canyon National Recreation Area and Grand Canyon National Park. This particular study focused on recreational effects. Three types of recreation were identified as being potentially affected by river flows: white-water boating, trout angling, and one-day raft trips.

Seven formal surveys were conducted. One was a mail survey of white-water commercial trip guides and private trip leaders to ascertain their views on how dam releases affect white-water boating. Samples of white-water boaters, anglers and day-use rafters each participated in "attribute surveys" to identify the important attributes of recreational quality and define which are sensitive to flows. Separate samples from the three recreation groups also participated in contingent-valuation surveys to quantify, in dollars, the effects of flows. In addition, this study used the expertise of fishing guides, rafting guides, resource managers, and other GCES researchers.

Glen Canyon Dam releases have substantial impacts on both trout fishing and white-water boating. Anglers placed the highest value, $126 per trip, on constant flows of about 10,000 cubic feet per second (cfs). Both lower and higher flows adversely affect fishing values. For example, a fishing trip is worth only $60 at a constant flow of 3,000 cfs and $94 at a constant flow of 25,000 cfs. White-water boaters prefer constant high flows in the 29,000 to 33,000 cfs range, with maximum values of $898 per trip for commercial passengers and $688 per trip for private white-water boaters. At a constant flow of 20,000 cfs, the commercial trip value declines to about $550, while the comparable figure at 45,000 cfs is $732. Daily fluctuations in flows are detrimental to both groups.

Day-use rafters' reported values were not affected by the range of alternative flows evaluated in this study.

Although flow preferences of white-water boaters and anglers appear to conflict, use data indicates that with the exceptions of May and September, the greatest use levels for each activity occur at different times of the year. Flow regimes combining high constant flows in the summer months of May-September with low to moderate constant flows for the remainder of the year would produce the largest recreational benefits. Under ideal conditions, annual benefits could be as high as $12.4 million.

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Each stage of this research project required a careful assessment of the results of previous stages and a well thought out plan for the accomplishment of future stages in the research process. Members of the Recreation Subteam made significant contributions to this process and the overall success of the study. Members of the Recreation Subteam are:

David Wegner, GCES Manager, U.S. Bureau of Reclamation
Michael O'Donnell, GCES Recreation Subteam Leader, U.S. Bureau of Reclamation
Martha Hahn-O'Neill, Grand Canyon National Park
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Nancy Brian, U.S. Bureau of Reclamation
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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

Page

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

CHAPTER 1

INTRODUCTION

Background

The research reported here is one part of the Glen Canyon Environmental Studies (GCES). The GCES are a joint research effort sponsored by the Bureau of Reclamation and the National Park Service focusing on the Colorado River below Glen Canyon Dam and above Lake Mead. When Glen Canyon Dam was completed and Lake Powell began filling in 1963, basic environmental parameters such as water temperature, silt loading, and annual stream flow patterns in the Colorado River below the dam were changed substantially. The result is a much modified aquatic and riparian environment along the nearly 300 miles of the Colorado River flowing through Glen Canyon National Recreation Area and Grand Canyon National Park. The GCES comprise a broad interdisciplinary project designed to determine the effects of flow release patterns from Glen Canyon Dam on that environment.

A wide range of flows can be released at the dam. When all eight turbines of the Glen Canyon Power Plant are in full operation, 33,500 cubic feet per second (cfs) of water is being released. In addition, there are four 96-inch diameter pipes (bypass tubes) that allow water to bypass the power plant. They have a combined capacity of 17,000 cfs. Under extreme conditions, when the reservoir (Lake Powell) is full, spillways capable of releasing an additional 278,000 cfs are also available.

At the other extreme, the dam is capable of releasing as little as 1,000 cfs, although minimal flows of 3,000 cfs in the months of April through September are generally maintained for environmental considerations and the benefit of downstream recreation. Additional constraints are placed on dam releases by legal and institutional requirements, and by releases from upstream reservoirs. Still, while operating within these constraints, there is broad latitude in choosing how much water will be released at any point in time and in choosing the pattern for water releases on an annual, monthly, or even daily basis. Different flow release patterns will have different effects on the downstream environment and the GCES are seeking to understand and document these effects.

The research reported here focused specifically on the relationships between stream flows and river based recreation in Grand Canyon National Park and Glen Canyon National Recreation Area, below Glen Canyon Dam and above Lake Mead. Although the casual visitor viewing the Grand Canyon from the South Rim may enjoy seeing the river, the quality of her/his experience is not likely to be heavily dependent on how much water is released from the dam. There are three groups of récreationists, however, that may be directly and substantially affected by stream flows. The first group will be referred to as "white-water boaters." These are people using a variety of rafts and boats to take a white-water trip on the Colorado River between Lee's Ferry and the Lake Mead. Such trips involve negotiation of the famous white-water rapids of the Grand Canyon. The second group is composed of "Glen Canyon anglers" who typically fish the Colorado River between the dam and Lee's Ferry. The third group of recreationists are "day-use rafters" in Glen Canyon. These people take one-day trips through Glen Canyon (above Lee's Ferry) on large, motor-driven rafts. The volume of water in the river is a potentially important parameter in the recreational environments of these three groups and the effect of varying flow release patterns from Glen Canyon Dam on these three groups is the focus for the research reported here.

Recreation and Stream Flows

White-water boaters typically depart from Lee's Ferry. They use a variety of craft with two types of distinctions being relevant for our work. First, boats are distinguished by whether or not a motor is used. "Motorized trips" utilize relatively large rafts, often measuring 37 feet in length and carrying as many as 25 passengers. Nonmotorized boats are generally smaller, and include oar rafts, paddle rafts, dories, kayaks, and occasionally other craft as well. The second major distinction is between commercial and private trips. Commercial trips are organized by 21 commercial rafting companies which, for a fee, supply guides, boats, food, and much of the other equipment needed by passengers. Private trips are organized by groups of individuals who provide their own equipment and supplies, usually sharing expenses. In 1985, 11,374 commercial passengers and 2,368 private boaters traveled down the Colorado River through Grand Canyon National Park.

Lee's Ferry plays a major role in Glen Canyon fishing in that it is the only major access point on the river for anglers. The National Park Service provides a boat launching ramp, dock, parking area, rest rooms, and a campground at this river location. Most of the fishing takes place in boats on the 15 miles of river upstream from Lee's Ferry. A smaller number of anglers fish from the shore near Lee's Ferry. Some fishing also occurs as an incidental activity on white-water boating trips, but there are not currently enough anglers fishing on these trips to warrant specific attention in this study. For purposes of this study, the effect of flow levels on incidental fishing on white-water trips will not be evaluated.

The current Glen Canyon fishery is a product of the Glen Canyon Dam. The cold water released from Lake Powell has combined with other ideal environmental conditions to create a very productive trout fishery with rainbow trout as the dominant species. Within a few years after completion of Glen Canyon Dam, anglers began enjoying an outstanding fishing opportunity with many fish of trophy quality being taken during the late 1960's and the 1970's. More recently, the number of trophy-sized fish taken by anglers has declined substantially, most likely as a result of heavy fishing pressure. As many as 52,000 angler days were recorded in the Glen Canyon fishery during 1983, but participation has been highly variable from one year to the next. In response to this trend in catch rates, the Arizona Game and Fish Department, as the agency that manages the fishery, has enacted increasingly stringent regulations to decrease fishing pressure and the number of fish taken by anglers.

Day-use rafters are people taking commercial raft trips through Glen Canyon above Lee's Ferry. This recreational experience is also a by-product of Glen Canyon Dam. The trips typically originate at the dam and participants spend the day floating/motoring down to Lee's Ferry. However, at relatively high flow levels when bypass tubes are in operation, trips depart from Lee's Ferry to avoid the turbulence below the dam, and motor upstream before floating down. Thus, the most obvious effect of flow release patterns on day-use rafters occurs when the bypass tubes are in operation. Participation in Glen Canyon raft trips has been growing in recent years with about 8,500 individuals taking a trip in 1985.

Goals and Approaches of the Study

The overall goal for the portion of the GCES reported here is to evaluate the impacts of alternative flow release patterns from Glen Canyon Dam on white-water boating, fishing, and day-use rafting on the Colorado River below the dam. To achieve this goal, four interrelated research procedures were implemented.

The first stage in the research involved "attribute surveys" of recreationists. The effects of varying flow release patterns are transmitted to recreationists largely through changes in the quality of the experiences. It was necessary to know more about the characteristics or attributes of the recreational experience that influence recreational quality and which of these attributes are influenced by stream flow. Consider white-water boating for example. Even casual observation of white-water boating would indicate that running rapids is an important attribute of a trip down the Colorado River. However, the relationships between recreational quality, rapids, and flow rates had not previously been documented. As flow rates increase, the hydraulics and waves at some rapids are intensified, while other rapids are washed out. How do boaters feel about this trade-off? At very high flows, safety concerns may become important, and passengers may have to walk around one or more of the major rapids. Also, how important are rapids compared to other attributes of the white-water boating experience? An understanding of the implications of alternative flow release patterns on the recreational experience requires a thorough understanding of the recreational activities, including the role of flow-sensitive attributes. This understanding was gained by conducting attribute surveys of individuals from all three recreation groups.

Second, our research drew on the knowledge of river guides. The people who serve as guides for commercial and private white-water trips, for anglers, and for day-use raft trips constitute an important group of experts on the relationship between flows and recreation. River guides have first-hand knowledge of the recreationists, the recreational experience, and the river itself. Some have years or even decades of experience, and a comprehensive study could not overlook such a rich source of knowledge. We conducted a formal mail survey of white-water boating guides and, because of the small number of people involved, made informal contact with fishing guides and day-use rafting company representatives.

Third, our research depended heavily on the help of resource managers and other researchers. At each step in the study, a working group composed of HBRS staff and GCES study managers from the Bureau of Reclamation and National Park Service reviewed progress and planned succeeding steps. The evolution of the study was shaped in many ways by these contacts. Members of the other GCES research teams also contributed valuable input, particularly those from the Arizona Game and Fish Department, the U.S. Geological Survey, and the University of Arizona.

The fourth, and final, step in the research involved "contingent-valuation surveys" of recreationists to quantify their preferences for a variety of flow release patterns in <u>monetary</u> terms. To do this, we applied a technique called "contingent valuation." Contingent valuation will be discussed often in this report and it will be convenient to use "CV" as an abbreviation.

CV is a technique developed by economists to measure monetary values for things that are not typically traded in markets. In the current case, for example, access to the recreational resources of the Colorado River is not governed by a market in the traditional sense of the word. Although recreationists may buy fishing equipment in a sporting goods store or pay a white-water boating firm to be a passenger on one of its trips, the recreational opportunities themselves are provided by the public sector and market prices for access are not available to serve as guides to their economic values. A CV study is accomplished by using surveys to ask recreationists what value they would place on access to a recreational resources if a market or other means of payment did exist.

In the applications of CV reported here, we first asked recreationists about the actual costs they incurred to make their Colorado River trip. It was relatively simple to define the specific trip to be valued for white-water boaters and day-use rafters, since it would be very rare for an individual to take more than one such trip in a given year. Thus, the first step in asking the CV question for white-water boaters and day-use rafters was to ask them in a mail survey about actual expenses for their 1985 trip. Anglers, however, often take more than one trip per year to fish in Glen Canyon. Consequently, anglers were interviewed at Lee's Ferry on selected days and then asked in a subsequent mail survey about this particular trip.

For all three groups, the next step was to ask respondents whether they would still take such a trip if their expenses had increased by a specified amount. This is the CV question for their actual trip, and their responses were analyzed to provide an estimate of how much the trip was worth to them over and above its costs. Finally, scenarios of recreational experience describing changes in flow levels or other flow related parameters were presented to respondents accompanied by a similar CV question. The information in the scenarios was based on the results of the attribute surveys and contacts with guides, resource managers, and other GCES scientists. The outcome of applying CV, then, was a dollar value per trip for the actual trip, and a dollar value for each of the alternative trip scenarios. These values were estimated for all three recreation groups.

The ultimate goal of the study was to assess the impact of alternative annual flow release patterns or "annual flow regimes" for Glen Canyon Dam on recreationists in the aggregate. This goal was achieved by modeling the relationships between flow levels and monetary values for each of the three groups of recreationists. Values per trip, based on the results of the CV surveys, gave estimates of how recreationists would value individual trips under actual conditions or conditions described in the scenarios. The evaluation of specific flow release patterns required combining the values of white-water boaters, anglers, and day-use rafters with the number of trips taken by each group in 1985 to produce an estimate of aggregate recreational benefits. A computer model was developed to calculate aggregate recreational benefits over a wide range of possible flow release patterns from the dam.

Some readers may find the use of monetary valuation in a recreational context confusing and perhaps disturbing. A great deal more will be said about CV and the potential usefulness (and pitfalls) of economic values for managing natural resources in the next chapter. Our objective in the current chapter is simply to provide an overview of our approach to evaluating the impacts of flow levels on recreation activities and to describe how this research was accomplished.

Study Plan

The components of the study are summarized in Figure 1-1. This flow diagram shows how the various parts of the study were integrated to accomplish the overall goal of evaluating alternative Glen Canyon Dam releases on Colorado River recreation below the dam and above Lake Mead. The contacts with guides, resource managers, and other GCES researchers were inputs for both the attribute surveys and the CV surveys. These inputs aided the design of these surveys, as well as the interpretation of the survey results. Surveys of recreationists were used to collect the necessary data to identify the attributes of these recreational experiences that are affected by flow levels (attribute surveys). The flow-sensitive attributes identified were used to guide the development of the CV surveys used to estimate the effects of different flow release patterns, as measured in dollar terms, on the recreational experiences. The values derived from the CV surveys formed the basis for the Flow Valuation Model. For specified annual flow regimes within the flow ranges covered by the model, aggregate recreational values for all white-water boaters, anglers, and day-use rafters were computed. Aggregate recreational impacts were calculated for five flow regimes which representatives of the Bureau of Reclamation specified as being representative of possible release patterns from Glen Canyon Dam.

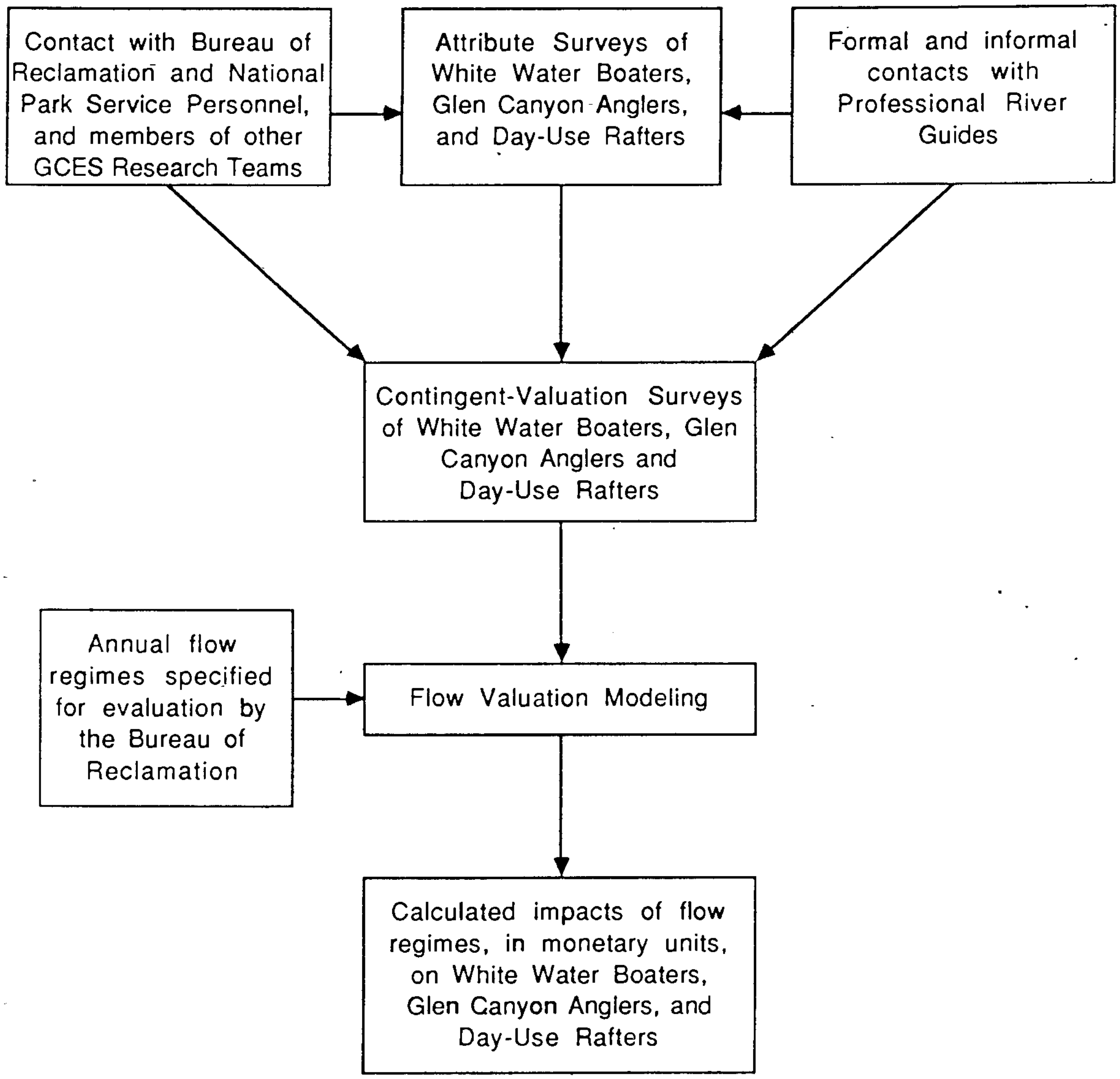
The remainder of this report is divided into 8 chapters (Chapters 2-9). Chapter 2 develops the conceptual model for estimating the relationships between river flows and economic values, and Chapter 3 describes the research procedures used to collect the necessary data to identify these relationships. Conclusions regarding the effects of Glen Canyon Dam releases on white-water boating guides, white-water boaters, Glen Canyon anglers and day-use rafters are presented in Chapters 4-7, respectively. Using the results reported in these chapters, five prototype flow release patterns from Glen Canyon Dam, which were given to all GCES teams for analysis, are evaluated and contrasted in Chapter 8 to identify the trade-offs affecting recreationists from varying operation of the dam. Chapter 9 presents the conclusions from our analysis of the effects of flow release patterns on the recreational experiences, and discusses the implications of these results for the management of flow release patterns from Glen Canyon Dam.

Summary

The components of this study were specifically 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. The results of these analyses will help the U.S. Bureau of Reclamation and the National Park Service evaluate the key trade-offs between flow levels and users enjoyment of these recreational activities. The evaluation of such trade-offs, however,

Figure 1-1

Diagram of the Relationships
Among Study Components



required a substantial data collection effort regarding the preferences of each user group and the knowledge of professional guides. Thus, the contributions of this study will extend beyond the findings presented in this report. Even though the text of this report only addresses the analyses of trade-offs between flow levels and user preferences, the data sets that were used in these analysis may be useful in analyzing a variety of other types of management issues.

CHAPTER 2

RECREATION VALUES AND PUBLIC DECISIONS

Introduction

The use of dollars to quantify the effects of Glen Canyon Dam releases on downstream recreation raises several issues that will be addressed in this chapter. First, why try to value such effects in dollars at all? We suggest in the first section that dollars provide a useful yardstick for measuring the public's preferences for resource management alternatives. Furthermore, the use of dollars has some distinct advantages when compared to other approaches for measuring preferences.

The second issue involves the definition of value. Value is a term that can take on many meanings, even within economics. A state-of-the-art application of economics to Colorado River recreation must apply standard, widely accepted definitions of value. For this purpose, we drew on standard concepts from benefit-cost analysis. In the middle sections of this chapter, the concepts of total value and surplus value, as defined in benefit-cost analysis, will be explained. These concepts will then be adapted to the problem of valuing the effects of Glen Canyon Dam releases on Colorado River recreation.

Toward the end of the chapter, two other issues will be addressed. As noted in Chapter 1, this study will employ contingent-valuation (CV). An alternative technique, the travel-cost method, is also used frequently in recreation valuation studies. A section is devoted to explaining why the travel-cost method was not used here. Then, given that the success of the study depends in part on the validity of CV results, it will be necessary to ask whether CV can be expected to provide valid dollar values. Selected studies that have investigated the validity of CV will be summarized.

Why Dollar Values?

Dollar values are used in everyday life to communicate relative importance. When we read, for example, that videotape recorders have become a billion dollar a year industry, this tells us something about how important these devices have become to consumers, and hence, to the industry and employees who produce them. In a sense, such dollar values convey something about the priority that our society is placing on them. Similarly, dollar values can be used to evaluate social priorities in natural resource management.

By definition, resource management involves choices among alternatives. This is certainly true when choosing appropriate flow release patterns from Glen Canyon Dam. As discussed in Chapter 1, a wide variety of daily and annual flow release patterns are technically feasible within the constraints set by the design features of the dam, the inflows of water from upstream, and legal and administrative requirements. Each potential flow release alternative has its own implications for power revenues; the well-being of terrestrial and aqtuatic ecosystems downstream; various recreational users of Lake Powell, Glen Canyon, and the Grand Canyon; water levels at Lake Mead; and the legal requirements for operation of the dam. Decisions about release patterns, thus, involve a complex balancing of many social priorities.

The priorities that government officials bring to bear on such questions are supposed to reflect the wants and needs of the citizenry. But, how are these wants and needs to be assessed? Traditionally, we have depended partly on elected officials and their appointees, operating within the constitutional system, to implement our preferences. Presumably, elected officials who too often make decisions contrary to public preferences will not be reelected. The wise public official has traditionally kept abreast of public preferences through contacts with individual citizens, especially key leaders among his or her constituency, and citizens' groups.

Frustrations among some segments of the public with the apparent unresponsiveness of government officials (both the elected and appointed) led to the installation of formal public participation mechanisms for some decision processes. Public hearings and other forms of public participation were designed to help decision makers gauge what the public really wanted, and to give the citizenry an official forum for expressing their preferences on specific issues.

In a similar vein, there has been a growing interest in using methods from the applied social sciences, including economics, to assess public wants, preferences, and priorities in a systematic and defensible way, and in more depth than is feasible through traditional public participation techniques. Economic methods have focused primarily on the measurement of public preferences in monetary terms.

Dollar valuation as a measure of public preferences, then, may be thought of as a yardstick for measuring the importance or intensity of preferences among members of the public for resource management alternatives. Dollar measures have a couple of desirable features when employed in this way. <u>First, dollars are a commonly used and easily understood unit of measure.</u> To say, for example, that Grand Canyon white-water boaters prefer flow Alternative A to flow Alternative B is certainly relevant information, but more information is communicated by saying that white-water boaters gain $100,000 more per year in benefits under Alternative A than they do under Alternative B. Dollars take on extra significance in an absolute sense because we measure the worth of so many things in monetary units. This is true for not only mundane things like bus rides or a can of beans, but for objects of art, classical music recordings, tickets to the Super Bowl, and vacations in exotic places.

The second advantage of using dollars to measure preferences is that they are easily added, subtracted, and compared. Other more qualitative measures of preferences are not easily reduced to a common denominator. Resource managers must inevitably work with aggregates of people. When a given dam release alternative affects both white-water boaters and Glen Canyon anglers, the dollar benefits accruing to each group can be added to measure the aggregate impact of that alternative. Perhaps more importantly, when user groups disagree, dollar values provide a basis for comparison. We can determine which alternative produces the largest total dollar benefits for each group separately or for all groups combined.

Methods for measuring these dollar benefits were developed to give resource managers and public officials an improved understanding of public preferences regarding resource management alternatives. To achieve this goal, it was necessary to define carefully what these dollar values mean so that they could be applied to a broad array of publicly provided goods, services and amenities in a uniform and consistent manner.

Value Definitions

It is important to recognize that the concepts of monetary valuation that are applied to Colorado River recreation in this study are not new. The general concepts defining monetary values are not only applicable to recreation, but to all sorts of goods and services. The use of these monetary values in resource management decisions in the United States began gaining momentum when the Flood Control Act of 1936 declared that Army Corps of Engineers water resource development projects were to be considered economically feasible only if "the benefits, to whom so ever they may accrue, are in excess of the estimated costs." This statement led to the development of a procedure for evaluating the feasibility of public projects that is called "benefit-cost analysis."

The concepts and tools of benefit-cost analysis have undergone continuous refinements over the past 50 years. Whenever an agency like the Bureau of Reclamation develops a proposal for a water project, a benefit-cost analysis must be performed. Procedures for estimating the so-called "National Economic Development (NED) Benefits and Costs" of such projects are presented in detail in the Economic and Environmental Principles and Guidelines for Water and

Related Land Resources Implementation Studies (U.S. Water Resources Council, 1983). The Principles and Guidelines, as this document is often called, are followed by all federal water resource agencies including the Corps of Engineers, the Bureau of Reclamation, the Tennessee Valley Authority, and the Soil Conservation Service. They are also widely recognized as an authoritative source on benefit-cost analysis by economists in many other agencies and outside of government as well. Valuation procedures for determining the benefits to society from municipal and industrial water supplies, agricultural products, flood control, hydroelectric power, navigation, commercial fishing, and recreation are covered.

Our purpose in introducing the Principles and Guidelines is to assure that the recreation benefits of alternative flows from Glen Canyon Dam are measured using standard, widely accepted definitions and procedures. We do not intend to imply that a full benefit-cost analysis is to be performed in this study. The goal here is the much more modest one of measuring recreation benefits alone.

The Principles and Guidelines provide a conceptual foundation for the evaluation of NED benefits based on the concept of willingness to pay. This concept is applicable to any situation where a public project increases the output of goods and services. It can also be applied where quality is improved and where costs of producing existing output are reduced. Value is defined as the maximum amount a consumer would be willing to pay for the outputs or other effects of a project rather than do without them. To further understand the willingness-to-pay concept, let us define the total value of the outputs and other effects of a project as the maximum that all members of society combined are willing to pay to obtain them -- or to avoid them if negative outputs (e.g., pollution) would occur.

Total value can be divided into two parts: market value and surplus value. Consider a project that only produces one output. The total value of that output equals the maximum amount consumers are willing and able to pay for it rather than do without it. Market value equals the market price of a unit of output multiplied by the units of output produced by the project. If, for example, an irrigation project causes an increase in the nation's supply of carrots, market value is equal to the price of carrots multiplied by the increased quantity produced. But some consumers may be willing to pay more for these additional carrots than they would actually have to pay in the market. This extra amount over and above what is actually spent is surplus value. The total value of the carrots equals their market value plus their surplus value.

In summary, total value can be broken down into market value (the amount the individual actually pays for the projects' output) and surplus value (the additional amount they would pay if they had to to do so). In economic terminology, surplus value is called "consumer surplus" since it accrues to individual consumers. Total value of the project's output is the sum of the maximum willingness to pay for all individuals affected by the project, including both market value and surplus value.

In the carrot example, the emphasis was on quantity, while the present study emphasizes quality. That is, the water level in the Colorado River is one of the potential determinants of quality for white-water boating, fishing, and day-use rafting. The goal is to measure in dollars people's subjective evaluations of qualitative changes in their recreational experiences. Still, the principles are the same whether the changes to be evaluated are quantitative or qualitative. To the extent that changes in flows enhance recreational quality, people would be willing to pay more per trip, i.e., they have larger surplus values. Similarly, if a change in flows reduces quality, recreationists would be willing to pay less per trip, i.e., they have lower surplus values.

It is these changes in value "at the margin," to use the economic term, that are of interest here. Referring again to the carrot example, notice that the goal was not to measure the value of all the carrots produced in a given region or the nation as a whole, but rather the carrots produced, at the margin, by the individual irrigation project. Likewise, our goal here is not to measure the total value of all Grand Canyon recreation. Rather, we will only consider the values of certain specific user groups for certain specific effects, at the margin.

Economic terms are easily misunderstood and total value is no exception. Thus, just to avoid misunderstanding, let us explicitly state that there is no intention in this study to measure the total value of Grand Canyon National Park or Glen Canyon National Recreation Area. To do so would require attention to many other user groups and to nonuse values as well. Nonuse values, such as option and existence values, may be important components of the total values of important environmental assets such as those under study here (see Krutilla and Fisher, 1975; Smith, 1983; Randall and Stoll, 1983; and Boyle and Bishop, forthcoming, for further discussion of option and existence values), but are beyond the scope of the current study. Here, we will examine only the total values associated with specific qualitative effects of Colorado River flows on specific user groups: the white-water boaters, anglers, and day-use rafters.

Two other general definitions will be useful. "Costs" equal the value of resources required to produce project outputs. They may include private costs (e.g., farm inputs to grow the carrots) or public resources (e.g., costs of a dam). "Benefits" associated with project output are defined as total value of the outputs minus the costs directly associated with their production and distribution.

These concepts are readily applied to recreation. In defining the conceptual basis for recreation valuation, the Principles and Guidelines state (p. 67), "Benefits arising from recreation opportunities created by a project are measured in terms of willingness to pay."

Consider Glen Canyon fishing as an example. The total value of access to the Glen Canyon fishery for any given year is the maximum amount that all anglers combined would be willing to pay rather than give up access for that year. The concept of market value must be modified, however. Fishing opportunities at Lee's Ferry do not directly pass through a market, but are provided subject only to paying for a proper fishing license. At the same time, any angler knows that fishing does cost money, not only for the license, but also for use of a motor vehicle, boat costs, equipment, meals, lodging or camping, etc. In recreation valuation, "expenditures" take the place of market value as the first component of total value. Surplus value (the second component) then equals total value minus expenditures.

The importance of including surplus values as well as expenditures in total values can be illustrated using a Glen Canyon fishing example. Suppose an angler from Page, Arizona, has a total value per fishing trip of $50, but spends only $10 on a Glen Canyon fishing trip, leaving $40 in surplus value. If, for example, a ticket booth were set up at the dock at Lee's Ferry, this angler would continue to come fishing so long as tickets were less than $40 per trip. At access fees over $40, he or she would stop coming. If we are going to measure the total value of a trip to this person, counting only the expenditure of $10 would undervalue what it is really worth. As a measure of the priority that the Page angler places on fishing access, we must count not only expenditures, but also surplus value. Application of the Principles and Guidelines procedures to white-water boating and Glen Canyon day-use rafting also requires the measurement of total values which include surplus values.

The arguments for including surplus values in total recreation values are relatively straightforward. If dollar values are going to be used to measure people's preferences, then it seems natural enough to measure their total values and not just their expenditures. The next step in the argument is not so easily grasped at first: In estimating the NED benefits from recreation, only surplus value are usually counted. Expenditures are usually not counted as part of national economic development benefits. To make the problem even more difficult, when the viewpoint changes from national economic development to local economic impacts, expenditures play a key role and surplus values are ignored. It will be helpful to deal with these issues immediately.

Benefits Equal Surplus Values, Not Expenditures

Major recreational resources like those found in Grand Canyon National Park and Glen Canyon National Recreation Area cause money to flow into local economies as recreationists from outside the area buy locally sold goods and services. Such expenditures are the "first round" of local economic effects. Later "rounds" occur as local businesses and households spend and re-spend this money. Substantial household income and local employment may be generated in the process. For example, a Glen Canyon angler from Denver spending money in a Page restaurant might be the first round. Part of the money might go to a waitress as wages (the second round). The waitress in turn might spend the money at the local supermarket (third round). If the supermarket manager spends the dollar to order more groceries from Phoenix, then the process ends so far as Page's economy is concerned. The usual way of measuring the effects of such expenditure flows is through the use of "multipliers." Local economic impact analysis attempts to measure the total impacts of expenditures by outsiders, such as recreationists, on local business activity, household income, and employment within the local economy.

Measuring local economic impacts can have important policy implications. Areas like northern Arizona have limited economic bases. Providing recreational opportunities that bring people into the area can make a substantial difference to local incomes and employment. Bolstering economic activity in such predominantly rural areas has long been a public policy objective.

Interestingly, surplus values have no role to play in analyzing local economic impacts. Because surplus values involve money that is not actually spent, it has no effect on local income and employment. For local impact analysis, only expenditures are relevant.

Turning to the national perspective, expenditures become less relevant. In fact, expenditures are normally costs rather than benefits. Returning to our hypothetical Page angler who has a total value per trip of $50 and spends $10 per trip, it costs society $10 worth of gas, fishing lures, etc. to provide a trip to this person. He or she gets $50 in total value, but incurs costs of $10, leaving $40 in surplus value.

At first, leaving expenditures out of the analysis of NED benefits from recreation seems to contradict what has already been said. If expenditures contribute to local income and employment, shouldn't these effects be considered benefits? Special exceptions exist, but in general, they are not included. Unless there are special circumstances to justify doing otherwise, local effects are assumed to wash out nationally. To take the present case, suppose that the recreational opportunities in Glen Canyon and the Grand Canyon did not exist. Recreationists would spend the money elsewhere and create local economic impacts there. The fact that white-water boaters, anglers, and day-use rafters are having positive local impacts in northern Arizona means they are not having local impacts elsewhere. Unless there is clear evidence to the contrary, local economic effects are assumed to balance out to zero nationally. Thus, local impacts are normally not counted in national benefits. The need to treat national economic development and local economic impacts differently is clearly spelled out in the Principles and Guidelines, Sections 1.7.2 and 1.7.4.

Adaptation of Value Concepts to Colorado River Recreation

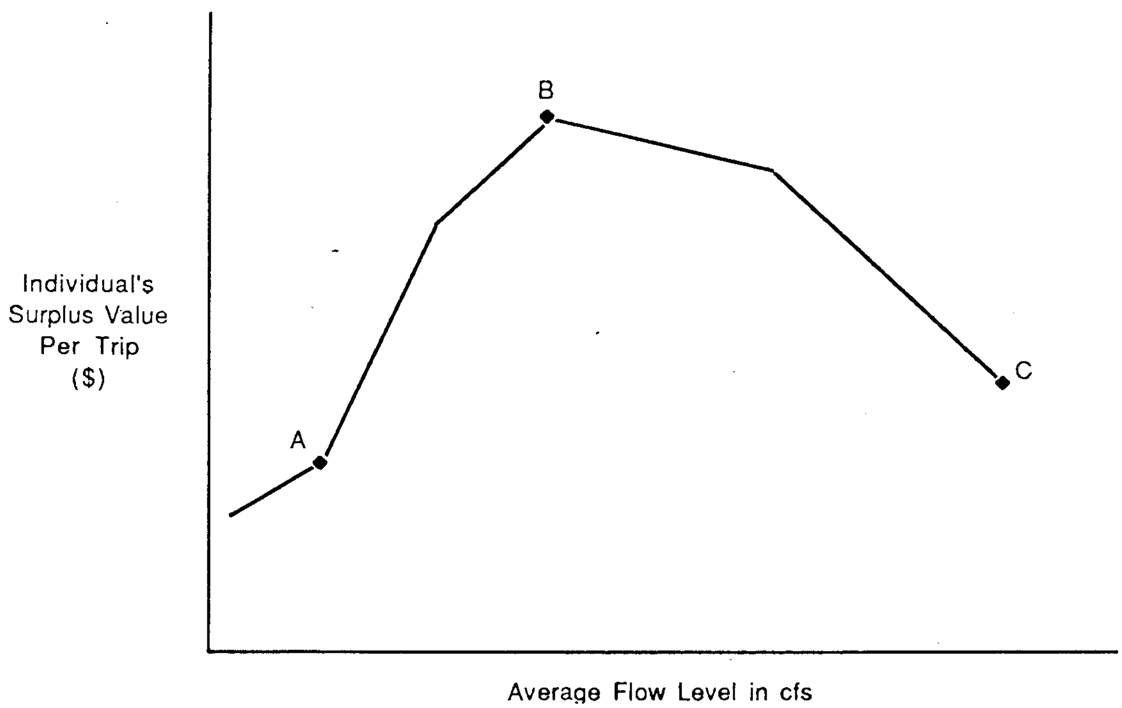
The goal of the economic portion of our study was to apply benefit-cost concepts to Colorado River recreation. It should be explicitly stated again, however, that this study did not attempt to do a full benefit-cost analysis of alternative Glen Canyon Dam flow release patterns. To have done so would have required a much larger project incorporating power benefits, potential impacts on Lake Powell recreation, and possibly many other implications of flow releases from the dam. Rather, the present project utilizes standard benefit-cost concepts to quantify one part of the benefits, the benefits to downstream recreation of varying river flows.

Let us begin with an individual recreationist. The relationship between stream flows and an individual's surplus values per trip might look like the curve postulated in Figure 2-1. On the horizontal axis, the flow rate in cubic feet per second is portrayed, while the individual's surplus value per trip can be read off the vertical axis. In this hypothetical example, at very low flows, such as Point A, surplus value for this recreationist is relatively low. Increasing the stream flow increases surplus value to point B where conditions are ideal from the perspective of this recreationist. Further increases in stream flow cause surplus value to decline toward point C.

Suppose that Glen Canyon fishing is being evaluated. Point A might represent a flow rate that is so low that it is difficult to maneuver boats up the river from Lee's Ferry without damage to the boat and/or its motor. Three Mile Bar, which lies upstream from Lee's Ferry, is difficult or impossible to pass when flows are quite low. Consequently, low flow levels tend to concentrate anglers in the three miles of the river above Lee's Ferry and may cause crowding. Low flows may contribute to reduced fishing quality in other ways as well. At point B, on the other hand, flows are at a level which creates ideal fishing conditions for this individual. At higher flows, such as point C, the current becomes more swift, the fish may be harder to find, and other effects may also reduce fishing quality and hence surplus value per trip. We will refer to such curves depicting the relationship between flows and surplus values as flow value curves.

Figure 2-1

Theoretical Flow Value Curve for an Individual



Of course, the specific shape of the flow value curve for any given recreationist would depend on the recreational activity and the characteristics and preferences of the individual. Many shapes are theoretically possible. For example, if there is a white-water boater who likes big rapids and, over a very wide range of flows, feels that the bigger the rapids the better the trip, then rather than turning down after point B, the curve might rise throughout. Figure 2-1 simply represents one of many possible shapes for the flow value function.

The ultimate goal of the CV portion of the analysis is to estimate the effects of alternative flow release patterns on surplus values for both constant flows and daily fluctuations in flows. Two methods of estimating such surplus values are well established: the travel-cost method and the contingent-valuation method (CV). Since CV was used in the study, it is worthwhile to briefly consider why the travel-cost method was not used.

Why Not the Travel-Cost Method?

The travel-cost method treats travel costs and other expenditures incurred to participate in a recreational activity as a measure of the market price for a recreational trip. The responses of people to these costs (as indicated by whether or not they make a trip) are used to estimate a relationship between total recreation expenditures per person per trip and the number of trips an individual chooses to make. Economists refer to this relationship as a demand function. This demand function is then used to estimate a surplus value per trip.

The travel-cost method can sometimes be used to estimate the total surplus value associated with recreation at a specific site. In fact, such a model has been developed for Glen Canyon fishing by Richards (1985). However, it is not clear that such a model could be successfully applied to white-water boating and day-use rafting. The vast majority of these recreationists take at most one trip per year, and many take only one trip in a lifetime. This would greatly impede application of the travel-cost method because the number of trips taken by any one individual in a given year does not vary. A so-called zonal model would have to be used and it is questionable whether the assumptions necessary for a zonal travel-cost model to work well would hold here. The problem is further complicated for white-water boaters by the Park Service ceiling on the total number of boaters that can launch each day and for the year as a whole.

Even if these concerns could be overcome, say by using one of the new probabilistic models like that proposed by McCollum (1986), the measurement of changes in surplus values due to qualitative changes like those under study here would be difficult using a travel-cost model. Such qualitative changes would be reflected in travel-cost analyses only to the extent that recreationists make more or fewer trips as a response to changes in flow levels. A white-water boating trip, for example, is planned months or even years in advance, and it is unlikely that people would change such plans based on the flows that happened to be in effect when the time for departure arrives, except under extreme conditions. Also, the National Park Service limits on the number and timing of white-water boating trips in the Grand Canyon further constrains the ability of white-water boaters to adapt their plans to flow levels. Although we argue that flow levels do not affect the number of trips taken by white-water boaters and day-use rafters, they may still enjoy one flow level more or less than another. If so, however, such preferences could not be identified with a travel-cost model.

Contingent valuation, on the other hand, is well-suited to evaluating the effects of such flow changes. It does not depend upon changes in travel behavior. Rather, it measures changes in recreationists' surplus values which reflect preferences for qualitative changes in the experience. For this reason, contingent valuation was used in this study.

On the Validity of Contingent Valuation

The contingent-valuation method derives its name from the fact that individuals are asked to state their surplus values for an item contingent on the existence of a market in which to trade the item or other means of payment. The elicitation of surplus values using CV is accomplished in a survey setting and no money actually changes hands. This can either be "willingness to pay" for access to the item or "compensation demanded" to forgo access. For the current discussion, we will focus on concerns regarding measurement of "willingness to pay" using CV questions since this is the approach used in the current study.

Many questions have been raised about CV in the 25 years since it was first applied by Davis (1963; 1964). Concerns have existed about whether money (surplus values) committed in a survey format can be taken as an accurate indicator of how people would behave if they really had to pay their surplus values. To provide the reader with a context for examining the credibility of the white-water boater, angler and day-use rafter surplus values, it is helpful to review the types of concerns that have been expressed and to summarize the results of several empirical studies designed to address such concerns.

Concerns about the accuracy of CV are generally treated as various classes of bias. Examples include strategic bias, information bias, starting-point bias, vehicle bias, and so on. Biases in general are discussed in Schulze, d'Arge and Brookshire, 1981; Desvousges, Smith, and McGivney, 1983; and Mitchell and Carson, 1981. We will categorize these effects under two general headings: strategic bias and hypothetical bias. Strategic bias would be present if respondents <u>intentionally</u> expressed surplus values in CV exercises that were different from what they would pay if real money was involved (i.e., the values they would express in a well-functioning market). In the present study, for example, white-water boaters on commercial trips might think that the fees outfitters charge could be affected by their responses to the CV questions. This might lead them to state values lower than they would actually pay if this concern was not present. They would do this to keep outfitter fees as low as possible. Likewise, if recreationists perceive that they could affect management decisions about actual stream flows, but not outfitter fees or other expenses, by stating higher values, then they might state larger values for preferred flow regimes than they would if they really had to pay the money. In either case, they would be intentionally misrepresenting their preferences in order to achieve what they perceive as a preferred outcome.

To the extent that it exists, hypothetical bias does not stem from intentional distortions, but rather, arises due to people's inability or unwillingness to engage in the mental processes necessary to predict what they actually would pay if required to do so. People who have never before tried to express their preferences for environmental assets in dollar terms may have a difficult time doing so on short notice while participating in a survey. Several possible effects of this uncertainty are plausible. Respondents may exercise conservatism by stating values that are relatively low compared to what they might really pay. Or, in CV questions, a means of payment, such as taxes or entrance fees, is usually specified to make the hypothetical situation seem realistic. Respondents may use the CV exercise as an opportunity to protest taxes or fees rather than to express their true preferences for the resource. If conservatism or protests regarding the hypothetical payment mechanism or some other similar reaction is dominant, CV values may turn out to be biased downward compared to true values. Alternatively, people who are uncertain about their true values might also express values that are high relative to what they would really pay in order not to be viewed as miserly or apathetic in the eyes of the researcher. Hypothetical bias is used to characterize these and other similar possible distortions because they all stem from the hypothetical nature of CV transactions.

In the context of the current study, Colorado River recreationists may find it difficult to determine just how much more they really would pay for a trip under specific flow conditions. To the extent that such difficulties result in an upward or downward distortion of values expressed in CV surveys, hypothetical bias would be present.

It needs to be emphasized at this point that all we have done so far is speculate about biases. No empirical evidence has been cited that indicates whether such biases actually exist, much less their direction and size. Indeed, most of the concerns raised about CV have involved only speculation. Empirical evidence, on the other hand, has been rather encouraging. CV measures of willingness to pay have generally been consistent with other methods of estimating values, and have been shown to be relatively free from the biases discussed above.

One empirical approach has been to compare CV and travel-cost values. The two methods have produced rather similar values in a number of studies (Knetsch and Davis, 1966; Desvouges, Smith, and McGivney, 1983; Bishop, Heberlein, and Kealy, 1983; and Sellar, Stoll, and Chavas, 1985). Comparison of CV values with the cost and prices of substitutes has been used to support the validity of CV by Thayer (1981).

Brookshire, et al. (1982) took a different track in a study of air pollution in the Los Angeles Basin. They and previous writers (see Freeman, 1979, for discussion and citations) argued that many people ought to be willing to pay more for property where the air is less polluted. Thus, by statistically analyzing data on housing values and housing characteristics including neighborhood air quality, they were able to infer willingness to pay for improved air quality using a statistical model of property values. This is a so-called hedonic price model. Separate estimates of willingness to pay were made using CV. The resulting hedonic and CV measures were shown to be consistent.

Much of the speculation about CV's potential inaccuracy has focused on the possibility of strategic bias. Yet, empirical attempts to discern strategic influences in CV results have either failed to show such influences to be present (see Schulze, d'Arge, and Brookshire, 1981, for discussion) or have shown the effect to be relatively small (Welsh, 1986).

This conclusion is supported by a substantial body of research results from laboratory experiments involving "public goods." Pure public goods are a general class of commodities and services where provision to any one member of society involves provision to all. Examples include national defense and radio signals. Since Samuelson's (1954) classic paper on the subject, it has been widely recognized at a conceptual level that people may have strong incentives to be "free riders" with regard to public goods. That is, by not revealing their surplus values, they can theoretically continue to consume a public good without paying. This would be strategic behavior much like that which would lead to strategic bias in CV studies. A number of laboratory experiments have involved public goods where, theoretically, people should have behaved strategically (Bohm, 1972; Scherr and Babb, 1975; Smith, 1977; Schneider and Pommerehne, 1981; Marwell and Ames, 1979, 1980; Alfano and Marwell, 1981; Brubaker, 1982; Tideman, 1983; Isaac, Walker, and Thomas, 1984; Kim and Walker, 1984). Strategic behavior appeared to be present to a modest extent in some cases, but was generally much less prevalent and much less influential than economic theory would lead one to expect. This suggests that strategic bias is not a major threat to the validity of CV. See Welsh (1986) for further discussion of this literature and its relevance to CV.

Further support for the validity of CV results has come from recent experiments involving "simulated markets." If it were easy to establish fully functioning markets for environmental assets like Colorado River recreation, CV would not be needed. However, it is sometimes possible to simulate markets in laboratory and field experiments, where actual cash transactions and CV exercises can be conducted and the results compared for the same applications. Such experiments provide very valuable evidence about how well CV is working.

Bohm (1972) conducted a laboratory experiment involving a closed-circuit television program. Several aspects of public goods valuation and allocation were studied, including actual cash transactions for admission to the program and contingent values. Bohm discovered evidence of hypothetical bias. However, the magnitude of the bias was not large (Bohm, 1972, p. 125).

A recent laboratory experiment was conducted at the University of Wyoming using undergraduates as subjects (Coursey, Hovis, and Schulze, forthcoming). The goal was to simulate, in the laboratory, an unpleasant environmental stimulus. The commodity used to accomplish this was a bitter, unpleasant, but harmless, substance called "sucrose octo acetate" (SOA). Part I of the experiment consisted of asking subjects how much they would pay hypothetically to avoid tasting the substance. Part II required three steps. In the first step, each subject tasted a few drops of SOA. In the second step, each was asked for a revised statement of willingness to pay to avoid consuming the full amount. In the third step of Part II, monitors attempted to increase respondents' statements of willingness to pay by bidding them up in $0.25 increments. In Part III, a group of eight individuals participated in auctions designed to elicit actual cash bids to avoid drinking SOA. At the end of the bidding, those who were the four high bidders actually paid their bids and did not have to drink the SOA, while low bidders drank. The results of this study revealed that contingent valuation performed quite well, with the bids in Parts I, II, and III being quite consistent.

In another recent experiment, CV was compared with a simulated market involving the sale of fresh strawberries (Dickie, Fisher and Gerking, 1985). Individuals in one sample of Laramie, Wyoming, households were contacted at home and given an opportunity to purchase strawberries. A second sample was contacted in the same fashion, except that hypothetical bids for strawberries were elicited. Each household, regardless of the sample, was given a set price for the strawberries and asked how many pints would be purchased. By varying the price across households, data were collected to develop a demand relationship between quantity purchased and price per unit. The demand function based on CV procedures was not statistically different from the demand function estimated on the basis of the actual transactions, indicating that the CV estimate of willingness to pay was a valid indicator of how subjects would behave when actual monetary transactions were involved.

Another simulated market experiment dealt with actual permits to hunt deer. Details are given in Welsh (1986), and Bishop, Heberlein, Welsh and Baumgartner (1984). By way of a quick summary, the deer hunting opportunities that were valued in that study took place in the Sandhill Wildlife Demonstration Area, a wildlife research area in Wood County in central Wisconsin. To maintain the Sandhill deer population at desired levels, annual public hunts are conducted. The economic research focused on one-day hunts for deer of either sex held in November, 1983 and 1984. Approximately 150 deer hunting permits were issued to hunters selected by lottery from over 5000 applicants in 1983 and again in 1984. In both years, CV estimates for Sandhill permits were compared to values based on actual cash transactions.

In 1983, only four permits could be sold. Auctions were thus conducted where the researchers sold permits to the four highest bidders. Other samples engaged in CV exercises measuring willingness to pay. The CV exercises were designed to be as much like the actual auctions as possible, except actual cash offers were not involved. In 1983, respondents were asked to state their surplus value for a deer hunting permit using two commonly employed question formats from CV studies. The same question formats were used in the CV studies and simulated markets to maintain comparability of the resulting value estimates. The techniques used to elicit surplus values are commonly referred to as "iterative-bidding" and "open-ended" questions (for an explanation of these techniques, see Boyle and Bishop, 1984; Anderson and Bishop, 1986; and Welsh, 1986).

In 1984, there was no longer a constraint requiring that only four permits be sold. Again, separate samples were involved in parallel CV and actual cash exercises so that responses to hypothetical and real dollar offers could be compared. Rather than using iterative-bidding or open-ended techniques, the 1984 experiment used "dichotomous-choice" questions. Dollar amounts to purchase a deer hunting permit were randomly assigned to hunters in advance and each respondent in the simulated market could either accept or reject the offer. Members of a separate sample were asked in a CV exercise to imagine they had received such offers and were asked whether they would accept or reject the specified amount.

CV yielded relatively accurate values for Sandhill deer hunting permits. There was not a statistically significant difference between values derived from the 1984 dichotomous-choice questions when CV and simulated market results were compared. Furthermore, the 1983 and 1984 CV results were quite consistent. It did not matter much whether iterative-bidding, open-ended, or dichotomous-choice questions was used in the CV exercises. Only the 1983 simulated market values were out of line. They were lower than all the other results (1983 CV, 1984 CV, and 1984 simulated market) and the difference was statistically significant. Welsh (1986) attributed strategic behavior in the 1983 simulated market to the auction formats that were employed since only four deer hunting permits could be sold. That is, when confronted with an actual cash auction, respondents intentionally bid lower than their true maximum surplus values in order to try to get a "good deal." However, strategic bias apparently did not have the same effect on bids in the CV exercise. In 1984, participants in the simulated market could only respond to a single opportunity to accept or reject a predetermined offer. This effectively eliminated the opportunity to behave strategically. The close correspondence between all the CV results and 1984 simulated market results indicated that CV worked well in both years.

By way of conclusions for the Colorado River recreation study, the weight of the evidence discussed above supports the use of CV measures of willingness to pay as a reasonably accurate approach to estimating surplus values. CV is capable, when competently applied, of yielding values that are comparable to travel-cost values and simulated-market values. The simulated market experiments provide particularly compelling evidence. Whether the product was as common as strawberries or as unfamiliar as SOA, values expressed in response to CV questions were statistically indistinguishable from values expressed in actual cash transactions. The deer hunting experiment provided evidence that this result carries over to recreational opportunities as well. Strategic and hypothetical bias do not appear to have substantial adverse effects on final value estimates. This body of research led us to expect CV to perform well in the study of Colorado River recreation.

Summary

The purpose of this chapter has been to review the conceptual and empirical basis for our study of Colorado River recreation. As such, a major goal of the study is to measure recreationists' preferences regarding dam operating alternatives in a commonly understood unit of measure, dollars. However, if dollars are to be used as a value measure, the definition of value must be consistent with general benefit-cost principles as recorded in the Principles and Guidelines. Since National Economic Development (NED) Benefits (and not regional benefits) are being measured, recreation benefits equal the surplus value generated by recreation, where surplus value is defined as the maximum willingness to pay of recreationists for access to Colorado River white-water boating, angling, and day-use rafting opportunities over and above actual expenditures.

To estimate surplus values for Colorado River recreation, CV willingness to pay was adopted. Although researchers continue to investigate the validity of CV measures, there is already ample evidence that CV measures of willingness to pay are sufficiently accurate to yield useful results. Though travel-cost models are sometimes used in such cases, constraints on the number of trips taken by white-water boaters and day-use rafters and other concerns make CV a more appropriate technique.

In the next chapter we develop the procedures that were used to accomplish the goals of the study, especially the development of the CV surveys for each of the user groups. Technical appendices will also be introduced, as needed, to elaborate on specific aspects of the analyses.

CHAPTER 3

RESEARCH PROCEDURES

Introduction

The ideal research design for this study would be a carefully controlled field experiment, where a representative sample of recreationists from each user group is selected and members of each sample would be asked to experience the activities under a variety of different flow release patterns. In this within-subjects design, each individual would experience all relevant flow release patterns. There were at least two major constraints to the use of a within-subjects design for this study. First, sampled recreationists would have been required to spend an unrealistically long period of time experiencing the various flows. For white-water boaters, in particular, the experimental treatments could have taken several months. Second, even if recreationists could have been recruited for such a study, it is unlikely that the operations of the Glen Canyon Dam could have been modified to permit the required variation in flow release patterns.

An alternative to a within-subjects design would be to use a between-subjects design. Two different types of between-subjects designs were considered. Over the last five years, a wide variety of flow levels and flow release patterns have been experienced by white-water boaters, anglers and day-use rafters. The first between-subjects design would have involved obtaining records of users from previous seasons and selecting a sample of users from each group which reflected a variety of flow release patterns. This design, however, was not used for two reasons. First, there are no records of Glen Canyon anglers. Thus, it is impossible to identify users from previous years. User records from previous years do exist for white-water boaters and day-use rafters, and samples of these two user groups from previous years were selected for the initial survey pretests. Respondents who had taken trips 2-4 years ago, however, were not able to recall as many of the specific aspects of their recreational experience as were more recent participants. To avoid confounding the analysis of the relationship between flows and users' evaluations of the experience, we decided not to sample recreationists from previous years.

A second between-subjects design could have been used if recreationists from a user group had collectively experienced a variety of flows in recent years. This design would involve selecting a sample from each user group to directly evaluate the flow release patterns they had experienced. Across the entire sample, then, the range of flow levels and flow release patterns would be evaluated. This method was used where sufficient variations in flows occurred. However, during the design of the study, we could not be guaranteed that recreationists would collectively have experienced sufficient variation in flow levels to make such an analysis possible. Consequently, an alternative method, using descriptions of the recreational experiences, was incorporated into the study design to determine users' evaluations of flow levels.

A two-stage procedure was used to develop and evaluate the scenarios. The first stage involved "attribute surveys" for each activity. These surveys were used to identify the important flow-sensitive characteristics or attributes of each experience. In the second stage, the results of the attribute surveys were used to construct descriptions (scenarios) of each recreational experience under different flows. The purpose of this step was to quantify respondents' preferences for a variety of flow conditions in monetary terms. The use of scenarios allowed the evaluation of a variety of flow release patterns even if the individuals in the samples had not collectively experienced all relevant flows.

The purpose of this chapter is to explain how each of these steps in the research process was accomplished. The chapter is organized around the four major tasks in this study. The first section describes the procedures used to administer the attribute and CV surveys. The second and third sections present discussions of the key design features of the attribute and CV surveys, respectively. Finally, the fourth section summarizes the procedures used in the analyses of responses to the CV questions and the calculation of estimated surplus values.

Survey Procedures

Background. A total of seven surveys were conducted for this study. Since it was not known which aspects of the recreational experiences were most important to participants and how those aspects were affected by flows, attribute surveys were conducted with white-water boaters, Glen Canyon anglers, and Glen Canyon day-use rafters. Samples of recent visitors from each of these groups received an attribute survey designed to identify the important characteristics or attributes of their experience and to identify which of these attributes, if any, are affected by flow levels. In addition to these three user groups, a sample of white-water boating guides and private trip leaders also received an attribute survey designed to identify the specific ways in which different flows affect the attributes of white-water boating trips in the Grand Canyon. These results provided the important information needed to design relevant CV surveys that would be easily understood by respondents.

Formal attribute surveys were not conducted with Glen Canyon fishing guides or day-use raft trip guides because of the small number of individuals in each of these groups. Only one company provides day-use raft trips, using less than 10 guides, and only 7 Glen Canyon fishing guides were identified from National Park Service records in 1985. Instead of a formal survey, input from these two groups of guides was obtained through informal interviews and discussions.

Contingent-valuation (CV) surveys were developed for white-water boaters, anglers, and day-use rafters. CV surveys were not conducted with any of the guides. The use of CV willingness-to-pay measures was not appropriate for guides because they are paid (rather than pay) to take recreationists on the river, and evaluation of the effects of different flows on guides' earnings from their guiding activities was not an objective of this study.

Sampling. For the white-water boaters and the day-use rafters, names and addresses of current-season users were obtained from permits records and trip rosters filed with the National Park Service and the commercial rafting companies. No such use records existed for Glen Canyon anglers, so on-site interviews at the Lee's Ferry boat dock were administered on selected days to identify the anglers' names and addresses.

For white-water boating guides, the National Park Service roster of qualified commercial river guides was used to select a sample of individuals who guide trips for commercial rafting companies. Permit application forms from private groups were used to identify the most experienced white-water boater (presumed for our purposes to be the trip leader) from private trips. Glen Canyon fishing guides were identified by Glen Canyon National Recreation Area personnel, while the single rafting company that provides day-use raft trips in Glen Canyon was contacted for information on that recreational experience.

Survey Techniques. Attribute surveys of white-water boaters, day-use rafters, and white-water boating guides were conducted using mail questionnaires. The attribute survey of Glen Canyon anglers was conducted with an on-site questionnaire administered at the Lee's Ferry boat dock and parking lot.

Contingent-valuation surveys followed similar procedures. White-water boaters and day-use rafters were surveyed using mail questionnaires. The Glen Canyon Angler CV Survey involved two steps. First, an on-site questionnaire was used to identify a sample and collect a limited amount of data specific to the trip when contact was made. Then, a mail survey was conducted to evaluate the trip when contact was made, as well as the different flow scenarios.

Where possible, mail questionnaires were used for the attribute and CV surveys for two primary reasons: cost and data quality. Mail questionnaire implementation costs are typically less than those for telephone and personal interview surveys. This is especially true when a relatively large amount of data is to be collected. The type of data required from the attribute and CV surveys also made the mail questionnaire format more appropriate. The attribute survey required a careful consideration of the characteristics of the recreational experience and decisions about the relative importance of each, while the CV survey required respondents to carefully evaluate several detailed scenarios of trips under different flow conditions. Such thoughtful responses would have been more difficult to achieve using a telephone survey.

On-site surveys for the Glen Canyon anglers were required because there are no existing records with which to identify users names and addresses. The on-site surveys were feasible because the Lee's Ferry boat dock and parking lot is the access point used by nearly all anglers. For the CV survey, a mail questionnaire was used to obtain anglers' evaluations of the alternative flow scenarios due to the complexity of the survey. The comprehension and evaluation of the individual scenarios would have taken more time than anglers would have been willing to spend on the dock or in the parking lot at the completion of a day of fishing, especially in unfavorable weather or as darkness was approaching.

Survey Pretests. All of the surveys, both attribute and CV, were "pretested." Pretesting allows the researcher to refine the survey instrument before a final survey is administered. Both attribute and CV surveys for white-water boaters and day-use rafters were pretested by mailing draft questionnaires to a sample of individuals from the respective sampling frames. The Angler CV Survey was pretested in this way as well. The Angler Attribute Survey was pretested using a small number of on-site interviews.

As noted in Chapter 2, there are several techniques of asking contingent-valuation questions, one of which is dichotomous-choice. In the design of the study we had concerns about which of the techniques would be best to use in the context of the current study. To address this concern, iterative-bidding, open-ended, and dichotomous-choice questions were used in the Angler CV Pretest Survey to examine the strengths and weaknesses of each technique. Respondents to this survey were randomly assigned to three groups and individuals in each group only answered one type of valuation question. Dichotomous-choice was chosen as the technique of asking the CV questions in the current applications. To address fully the procedures and results of the comparison of techniques conducted in the angler CV pretest would be tangential to the body of the report. However, the interested reader can refer to Appendix K for a complete discussion of the comparison of CV techniques in the Angler CV Pretest Survey.

A formal pretest of the white-water guides survey was not conducted. Instead, a draft of the questionnaire was evaluated in a focus group discussion involving commercial white-water guides who had a substantial amount of experience running the Colorado River between Lee's Ferry and Lake Mead. A focus group discussion was deemed to be the appropriate format for refining this questionnaire due to the number and complexity of the questions to be evaluated.

The primary objectives of the pretests were to assess the clarity of the questions and the comprehensiveness of response categories, as well as to "pinpoint" problem questions that respondents might find difficult to answer. No attempt was made to draw inferences about the effects of different flows from pretest data due to the small sample sizes involved. In addition, the pretests of the CV surveys were used to calibrate the CV questions. The dichotomous-choice technique, used to ask the CV questions, involved asking respondents whether they would pay a given dollar amount (offer) above and beyond their actual trip expenditures to take a specified white-water trip, fishing trip, or day-use raft trip. Data on the range and distribution of each group's surplus values were required to select the specific offers for the dichotomous-choice valuation questions in the final CV surveys. This calibration process and the selection of specific offers is discussed in more detail later in this chapter.

Survey Implementation. The procedures used to administer the attribute and CV mail surveys were consistent across the three recreational user groups. Where mail surveys were used, individuals in the sample were first mailed an advance letter informing them of the attribute survey. Five days later they were mailed a cover letter, a question and answer sheet, and a questionnaire. The purpose of the question and answer sheet was to respond to some of the concerns respondents might have regarding why the survey was being conducted. A postcard was sent three days after the questionnaire to thank those who had responded and encourage those who had not responded to do so. Nonrespondents were mailed a second copy of the questionnaire approximately two weeks after the first mailing of the survey, and a third copy of the questionnaire was sent by certified mail about four weeks after the initial survey mailing.

For white-water boating guides a slightly longer interval between mailings was used, and the third mailing was sent by regular first class mail. These alterations in the procedures were used because many commercial river guides move about a great deal, and we were concerned that the addresses we had obtained were not current for some individuals. A three week interval between mailings was used so that the previous mailing would have time to be forwarded to reach a respondent if necessary. A certified mailing was not used because there was a higher likelihood that the respondent would not be at the specified address, mitigating the response inducing qualities of the certified letter.

The administration of the attribute survey and the on-site portion of the CV survey for Glen Canyon anglers involved contacting anglers according to a predetermined sampling pattern as they returned to the dock at Lee's Ferry in the late afternoon or as they fished from shore near the Lee's Ferry parking lot. Procedures here will be explained further in Chapter 6 and related appendices.

Designing the Attribute Surveys

The objective of the attribute surveys, as has been previously stated, was to identify the important aspects of the recreational activity that are affected by releases from the dam. This was accomplished by designing survey questions to identify the important attributes that contribute most (positively or negatively) to the recreational experience. Informal interviews with resource managers and members of the appropriate group of river guides were used to assist in the identification of the particular aspects of each activity that should be addressed in the attribute surveys. A pretest was also used to identify appropriate response categories.

Although there were many questions in each of the attribute surveys, three questions were particularly useful in identifying important attributes. In the white-water boater and day-use rafter attribute surveys, three open-ended questions were asked before any specific attributes had been suggested to respondents. In the first question, respondents were asked about their reasons for taking a trip (see Figure 3-1). Second, respondents were asked to identify the specific things (attributes) that would contribute most to an excellent or perfect trip. An example of this question for white-water boaters is shown in Figure 3-2. Next, a similar question asked respondents to list the things that would contribute most to a poor trip. An example of this question for day-use rafters is shown in Figure 3-3.

The purpose of these open-ended questions was to give respondents an opportunity to choose their own response categories before being exposed to the attributes that had been specified by the researchers. Responses to these open-ended questions were examined to determine if any of the reported attributes could be affected by releases from the dam.

For the Glen Canyon angler attribute survey, questionnaire length and time constraints imposed by the use of an on-site interview limited the number of questions that could be asked, so the open-ended attribute questions were not used. Instead, a closed-ended question format was used for rating the importance of the positive and negative attributes of the Glen Canyon fishing experience. However, one of the response categories was open-ended so that anglers could cite their own reasons if they felt the provided answer categories

Figure 3-1

Question Asking White-Water Boaters About the Most Important Reason for Taking Trip

When you first decided to take a Grand Canyon trip, what was the <u>**ONE**</u> thing you looked forward to most?

____

Figure 3-2

White-Water Boater Positive Attribute Question

What things would contribute most to an <u>excellent or perfect</u> raft trip in the Grand Canyon <u>for you</u>?

____

____

____

Figure 3-3

Day-Use Rafter Negative Attribute Question

What things would contribute most to a <u>poor</u> one-day raft trip in Glen Canyon <u>for you</u>?

____

____

____

were not appropriate for them. An example of the closed-ended positive attribute question for anglers is shown in Figure 3-4. For each attribute, anglers were asked to rate the importance on a scale from 1-3, with "not important" rated as 1, "somewhat important" rated as 2, and "very important" rated as 3.

To determine the "important" attributes of each experience, responses to the closed-ended questions asking about specific attributes and the frequency with which respondents cited attributes in responding to the open-ended questions were analyzed. Attributes with the highest relative rankings for the closed-ended questions and those cited most frequently for the open-ended questions were determined to be important. Convergence of responses from both types of questions was examined to confirm that the identified attributes were in fact important. These results were then examined in light of comments by resource managers from the National Park Service and the findings from contacts with guides to determine the attributes that are affected by flow levels. When possible, we also examined respondents' answers to learn whether responses to the attribute questions varied with the actual flows experienced. This type of analysis could help to confirm whether attributes are or are not sensitive to flow levels. Finally, subgroups of respondents were examined to see if individuals who had more experience with a variety of flow levels might answer the attribute questions differently from those with less experience.

To complement these open-ended questions, a series of questions about the respondent's experience and specific characteristics of the trip were asked. These questions were developed using input from guides and resource managers. Based upon the results of the attribute surveys for each activity, the important, flow-sensitive attributes of each activity formed the basis for the construction of the scenarios for the CV surveys describing the change in the experience that would occur under different flow conditions.

The results of the attribute surveys and the specific flow-sensitive attributes identified for each activity are discussed in Chapters 4 through 6.

Designing the Contingent-Valuation Surveys

Six issues must be dealt with in designing a CV study: (1) Whose values will be estimated? (2) How will the item to be valued be defined? (3) What payment vehicle will be used? (4) How will the CV question be posed? (5) How will the data be analyzed? and (6) What supplemental data will be required? Let us consider how each of these issues was resolved in designing the current study.

Figure 3-4

Glen Canyon Angler Positive Attribute Question

How important would each of the following be in contributing to an <u>excellent or perfect</u> fishing trip at Lee's Ferry for you? (CIRCLE ONE NUMBER FOR EACH ITEM)

	Not Important	Somewhat Important	Very Important
Catching a trophy fish	1	2	3
Catching your limit	1	2	3
Good weather	1	2	3
High water level	1	2	3
Low water level	1	2	3
Camping along the river	1	2	3
Seeing few others	1	2	3
Rising water level during the day	1	2	3
Falling water level during the day	1	2	3

Other ____

Values to be Estimated. Concerning whose values will be estimated, it was decided that white-water boaters, Glen Canyon anglers, and day-use rafters would be directly affected by flow releases from Glen Canyon Dam. The final surplus values were based on samples drawn from 1985 visitor rosters.

Still, it is worth noting that other people may also be indirectly affected. In particular, Grand Canyon National Park is a major national environmental asset. If other sections of the Glen Canyon Environmental Studies identify clear links between stream flows and damages to the aquatic or riparian ecosystems, there could be substantial surplus values associated with the existence of certain resources in the canyon, as well as additional surplus values associated with the option of future use which should be included in a full benefit-cost analysis. (For further discussion of option and existence values, and relevant citations see Fisher and Raucher, 1984; Randall and Stoll, 1983; Smith 1984; and Boyle and Bishop, forthcoming.) Because such environmental effects were not documented when this study commenced, because option and existence values are more controversial and less well-researched than use values, and because project resources were limited, it was decided that the current study would deal only with the use values of the three groups who would be directly affected by flows.

Definition of Item. When people are asked to state a surplus value in a CV exercise, they must have a clear idea of what they are valuing. Thus, a second issue in designing a CV study is how to define the "item" to be valued. In the present study, three kinds of "items" were valued. First, all three groups valued an actual trip. Since day-use rafters and white-water boaters would not, in all probability, have taken more than one trip during 1985, they were simply asked to value the trip taken in 1985. Many Glen Canyon anglers, however, take more than one trip per year. This problem was alleviated by the use of the on-site sample selection so that anglers could be asked to value the trip taken on that date. To help anglers recall this trip, we asked them for some information in the on-site interview about their trip (see Appendix G) and used this information in the CV survey to jog their memories about the trip (see Appendix H).

In addition to actual trips, anglers and white-water boaters were asked to value two types of scenarios: "flow scenarios" and what might be termed "environmental impact scenarios." After respondents had answered a CV question for their actual trips, they were asked to value trips at several alternative flow levels as described by flow scenarios. Since many, if not most, of the respondents had only experienced a limited number of flow levels, it was necessary to describe the implications of flows for the quality of the trip. The flow scenarios described trips under different flow conditions, primarily in terms of the changes that would occur in the important, flow-sensitive attributes identified in the attribute survey. These scenario descriptions were supplemented with the information gained from contacts with guides and resource managers. A great deal of effort was exerted to insure that the scenario descriptions were based on documented facts about the recreational experiences and that they were worded in neutral, matter-of-fact language.

Even if scenarios are designed to be meaningful and to give detailed descriptions, a short description in a questionnaire is not a perfect substitute for actual experience. Thus, where possible, we also designed CV questions to assess the economic value of alternative flows based on the variation in flow conditions actually experienced by respondents. This was done by developing direct statistical relationships between flow rates and surplus values. Our ability to develop this relationship, however, was constrained by the range of flow levels and types of flow release patterns that recreationists experienced in 1985, an atypical year of relatively high constant flows. To fully model the relationships between surplus values and constant or fluctuating flow levels, it would have been necessary to manipulate releases from Glen Canyon Dam in ways that would have allowed adequate subsamples of recreationists to experience both constant and fluctuating flows across a full range of average daily flows from perhaps 3,000 to 40,000 cfs. Furthermore, it would have been desirable to vary flows randomly in order to reduce the risk of having unrecognized seasonal or other influences in the data.

The Bureau of Reclamation could not guarantee at the outset of the GCES that they could manipulate the dam in ways that would make it possible to select samples of individuals who, as a group, would have experienced all of the relevant flows to be evaluated. After all, Glen Canyon Dam is a large facility whose operation is constrained by many requirements dictated by social, legal and governmental institutions, design characteristics, and the variability of nature. Consequently, the ability of the Bureau of Reclamation to provide the flows needed for this study was limited. Thus, the scenarios provided an alternative way of meeting study objectives if data to estimate direct relationships between flows and actual trip values could not be generated.

The second type of scenario evaluated in this study involved direct environmental impacts. One of the disadvantages of carrying out various phases of the Glen Canyon Environmental Studies simultaneously was that the conclusions of other researchers were not available until near the end of the GCES. For our study, this meant that the impacts of flows on key recreational parameters, such as the size and number of beaches available for camping on the white-water trips, were unclear. Nevertheless, many potential environmental impacts were stated at the outset. To anticipate the implications for recreation if some of the more relevant potential impacts were verified, scenarios were designed where conditions were exactly like those on the actual trip except that one environmental parameter, important to that experience, was changed. A CV question was designed to measure the value of this modification in the actual trip.

Payment Vehicle. The third issue to be dealt with in CV study design is the determination of the "payment vehicle." CV questions normally specify a means or method of payment. In the present study, trip expenditures were used as the payment vehicle. Respondents were first asked about their actual trip expenditures. This step was designed to help them begin to think about their trips in monetary terms. In the technical language introduced in Chapter 2, the expenditure question was designed to focus respondents' attention on the market value portion of the total value. CV questions for the actual trip and scenarios then asked respondents how much more they would be willing to pay in additional trip expenditures. Thus, surplus value was measured in terms of potential additional expenditures to meet the cost of recreation.

Trip expenditures were chosen as a payment vehicle because they meet the key criteria of being both realistic and neutral (Mitchell and Carson, 1981). The purpose of the payment vehicle is to help make the CV question seem realistic to the respondent. Trip expenditures are a very real part of the experience for most adult participants. Neutrality is important to ensure that the payment vehicle does not draw too much attention to itself, but allows the respondent to focus on the item to be valued. For example, taxes are a realistic payment vehicle for some publicly provided amenities, but using taxes as a payment vehicle might cause respondents to concentrate on protesting current tax rates rather than expressing the value they place on the amenity. Trip expenditures appear to be relatively immune to such effects.

Choice of a Contingent-Valuation Technique. The fourth issue in designing CV studies is to determine how the CV questions will be asked. In the present study, the technique used is termed "dichotomous-choice." This method asks whether the respondent would or would not pay a prespecified amount (the "offer"), an amount in our case that would be over and above actual trip expenses. The prespecified amount is varied randomly over respondents. This technique is dichotomous in the sense that respondents have only two choices: yes, they would pay the increased expenses, or no, they would not. The yes/no responses are analyzed along with the amount of the offer and other variables to estimate surplus values. The method of analysis will be explained in the next section.

Data Analysis. The fifth issue in designing CV studies regards the methods used to analyze responses to CV questions to obtain estimates of surplus values. This is a somewhat complicated technical problem, especially for the analysis of dichotomous-choice responses, and the next major section of this chapter is devoted to an explanation of the analytic procedures used in this study.

Supplemental Data Required. The sixth issue relates to the types of data to be obtained in the surveys in addition to CV data. Normally, it is possible to augment value information in ways that support resource management. The present study gathered attribute data not only to facilitate the formulation of scenarios, but also because information on what contributes positively or negatively to trip enjoyment may be directly useful to the National Park Service in managing river trips. Furthermore, attribute data provided valuable information for assessing the success of the CV exercise. Consistency between results from the attribute surveys and CV results is to be expected. If, for example, flow level A is preferred to flow level B based on attribute data, flow level A should have a higher surplus value. If attribute and CV results are contradictory, then the interpretation of results would be difficult.

The CV surveys conducted in this study also gathered detailed socioeconomic data on the user groups studied. These data were needed to facilitate analysis of the CV data, to compare individuals in the CV samples to those from the attribute survey samples and may also be of direct interest to resource managers.

The survey design decision just discussed can be illustrated by presenting several examples of the questions employed in the surveys. Figure 3-5 shows the expenditure question for anglers followed by the CV question for the actual trip. Notice the definition of the "item" to be valued (actual trip), the expenditure vehicle (increased expenditures), and the dichotomous-choice format for the CV question. The blank in the CV question was filled in with a randomly assigned offer. Figure 3-6 is the 5,000 cfs (low water) constant flow scenario presented to white-water boaters along with the associated CV question. Figure 3-7 presents an example of an environmental impact scenario from the angler survey, where the postulated trip would be comparable to the respondents' actual trip except that the chances of catching a fish larger than three pounds would be doubled.

All of the CV questions were designed so that their format would be consistent across surveys of user groups, and between actual trip and scenario questions. It is important to note that the CV questions for each of the scenarios were tied to respondents' actual trips. To remind white-water boaters of their actual trip, they were told, in the survey, the date of their trip and the average flow levels experienced. In a similar way, anglers were reminded of the date of their actual trip, as well as the number of fish they reported catching and the size (pounds and inches) of the largest fish caught on that day.

Figure 3-5

Glen Canyon Angler Expenditure and Actual Trip CV Question

As near as you can recall for the trip when you filled out our short survey, about how much was your share of total trip expenses for the following items? (Include only money you personally spent. If you didn't spend money on a certain item, please put $0). [PLEASE CALCULATE AND FILL IN THE TOTAL ON THE LAST LINE].

Gas and Oil for vehicle	$________
Food and Beverages	$________
Lodging, Camping	$________
Fishing equipment/bait/license	$________
Guide fees	$________
Boat/equipment rental	$________
Airfare	$________
Car rental	$________
Other ______________________	$________
______________________	
TOTAL YOU SPENT ON THIS TRIP	$________

Would you still have gone on that particular trip to Lee's Ferry if your expenses had been $______ **more** than the total you just calculated? (CIRCLE ONE NUMBER)

1 YES, the trip would still be worthwhile

2 NO, it would not be worthwhile

Figure 3-6

White-Water Boater Constant Flow Scenario (5,000 cfs) and Associated Valuation Question

At a constant flow of 5,000 cfs, the speed of the river is relatively slow, reducing time for side canyon visits and other attractions. Boaters must break camp early to stay on schedule. Although rapids are present at this low water level, the waves are smaller and do not produce the big "roller coaster" ride created by higher flows. Due to exposed rocks, some rapids may be so difficult that it is likely passengers would have to walk around them. However, camping opportunities are abundant with many large sandy beaches exposed.

We would now like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white-water trip. Imagine that the trip would be the same as your last trip (e.g., the same people, same food, etc.) with <u>two exceptions</u>:

The water level would be constant at 5,000 cfs

AND

<u>Your individual</u> costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

Figure 3-7

Glen Canyon Angler Environmental Impact Scenario (Larger Fish) and Associated Valuation Question

A survey of anglers at Lee's Ferry last year showed that about 15 percent of them reported catching a fish larger than three pounds, and only 3 percent reported catching a fish larger than four pounds. These numbers reflect how an average angler might do on any particular day at Lee's Ferry. We realize that no one is exactly average, but we would like you to suppose that the fishery at Lee's Ferry changed in such a way that <u>your</u> chances of catching one of these bigger fish were to double. If you feel you are an average fisher, your chances of catching a fish bigger than three lbs. would now be about 30 percent, while your chances of catching a fish bigger than four lbs. would now be about 6 percent. If you think you are <u>not</u> an average fisherman at Lee's Ferry, your chances would vary accordingly.

Now we would like you to imagine you are deciding whether or not to take a trip to Lee's Ferry. On this trip all of the fishing conditions (water levels, weather, number of other anglers coming to Lee's Ferry, etc.) would be the same as the trip when you filled out our survey with <u>two exceptions</u>:

<u>Your</u> chances of catching a big fish (over 3 pounds) would be doubled

AND

Your expenses of a trip to Lee's Ferry increased by $ _____
(over the total you calculated on page 3)

Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

In addition, the valuation sections in both surveys were preceded by a series of questions asking respondents about the characteristics of their actual trip and questions asking them to evaluate the trip in qualitative terms.

The dichotomous-choice question formats generated "yes" or "no" responses to the CV questions. The offer amounts as specified in each question, and other data regarding the characteristics of respondents and their views of the the recreational experience were used as the basis for estimating surplus values. The nature of the analyses employed to derive the surplus values are discussed below.

Estimating Surplus Values from Dichotomous-Choice Responses

This section explains the derivation of surplus values from responses to the dichotomous-choice questions. This process is first discussed generally, and then in more specific detail using the appropriate technical terms. Though the more technical discussion may not be fully understood by some readers, our goal is to give all readers, regardless of their background, a basic understanding of the derivation of these surplus values which are discussed in the succeeding chapters.

The dichotomous-choice approach has advantages for the current study, as explained below. However, one of the disadvantages is the nonintuitive nature of the data analysis. The data analysis would have been much simpler to explain had we used open-ended or iterative-bidding questions where respondents were specifically asked to state their surplus values. With these techniques, a simple average of the stated surplus values could have been calculated to determine the average value per trip.

Responses to dichotomous-choice questions are not as easily analyzed. Suppose, for example, that a respondent answers "yes" to a dichotomous-choice question involving an increase of $100 in expenses for an actual trip. This response indicates that the respondent's surplus value is <u>at least</u> $100. There is no way to tell from simply observing a "yes" response how much above $100 an individual's surplus value is. Nevertheless, by analyzing the yes and no responses of a large number of recreationists, the estimated surplus value per trip can be computed.

A simple example will illustrate how surplus values are calculated from dichotomous-choice data. Suppose for the sake of argument that there is another group of recreationists on the Colorado River who prefer to travel by innertube. "Tubing," however, is not very popular, having only four participants, each of whom takes one trip per year. Suppose that one "tuber" has a surplus value of $100 per trip, two have surplus values of $200 per trip, and the fourth has a surplus value of $300 per trip. Suppose also that we ask all four an open-ended CV question to obtain this information, and they all truthfully report their full surplus values. The average value is calculated as follows:

$$\text{average value per trip} = \frac{\$100 + \$200 + \$200 + \$300}{4} = \$200$$

The same average can also be constructed as a weighted average. Twenty-five percent of the tubers (1 out of 4) would pay $100 but no more; 50 percent, $200, but no more; and 25 percent will pay $300 but no more. Thus, the following weighed average value can be calculated:

$$\text{average value per trip} = 0.25(\$100) + 0.50(\$200) + 0.25(\$300) = \$200$$

This $200 is the same average value per trip as was calculated before. It was simply calculated in a different way.

While it is less intuitive at first, a third way of calculating the same average value -- and the way most relevant for understanding dichotomous-choice values -- is to proceed in $100 increments. All four tubers (100%) are willing to pay $100. Seventy-five percent are willing to pay an additional $100. These are the people with surplus values of $200 and $300. Twenty-five percent (the person with a surplus value of $300) are willing to pay an additional $100 increment above $200. No one is willing to pay more than $300. Thus, the following weighted average can be calculated:

$$\text{average value per trip} = 1.00(\$100) + 0.75(\$100) + 0.25(\$100) = \$200$$

Again, the same $200 weighted average value per trip is obtained. The reason for proceeding in increments is to avoid double-counting. For example, in the first step $100 of value was counted for everyone (100 percent of the tubers). Thus, it was not necessary to recount the first $100 again when we considered willingness to pay at $200 and $300. The same argument is applied at each increment.

In actual CV surveys, any given tuber would normally be asked only one CV question regarding his or her actual trip, but the principles would be the same. Suppose that there are 4,000 tubers rather than four. By asking hundreds of tubers a dichotomous-choice question with a randomly assigned dollar offer chosen from a broad range of values, the probability of a respondent saying "yes" or "no" at various dollar amounts can be estimated. These probabilities can then be used to calculate an average value per trip using the same principles as were used in calculating the weighted average based on increments.

All of this can be readily interpreted in terms of probability theory. Let x be a random variable representing tubers' surplus values. Let F(T) be the probability that a randomly selected tuber would respond "no" to a dichotomous-choice offer of \$T. F( ) is a cumulative distribution function because anyone unwilling to pay \$T should also be unwilling to pay all larger amounts. Thus, F(T) gives the probability that \$T is greater than the maximum willingness to pay (above and beyond trip expenses) of a randomly selected tuber. In turn, the probability that this individual will answer yes to an offer of \$T is [1-F(T)].

Hanneman (1984) has shown that the expected value E(X) of surplus values, or maximum willingness to pay, for the population can be calculated from a continuous distribution as:

$$E(X) = \int_{0}^{\infty} [1-F(T)]dt. \qquad (1)$$

For a discrete distribution, equation (1) can be rewritten as:

$$E(X) = \sum_{i=1}^{n} [1-F(T_i)](T_i - T_j) \qquad (2)$$

where n is the number of discrete values taken by T, and T_j corresponds to the i-1 value of T. Thus, T_i is always greater than or equal to T_j. A more detailed discussion of the technical considerations for specifying the cumulative distribution function and for dichotomous-choice estimates of surplus value is presented in Appendix L.

The application of Equation 2 can be illustrated using the simple four tuber example. A graphical representation is presented in Figure 3-8. The horizontal axis shows surplus values per trip and probability of answering no to a dichotomous-choice offer is shown on the vertical axis (T_1=\$100, T_2=\$200, and T_3=\$300). The cumulative density begins at zero, since the probability that a member of this population will answer "no" at amounts less than \$100 is zero. It jumps to 0.25 at \$100, the maximum surplus value of 25 percent of the population. In mathematical terms, F(100)=0.25. At \$200, the F(200)=0.75, since the \$100 person and the two \$200 people would start saying no at amounts greater than \$200, and F(300)=1.00 because everyone would say "no" at amounts greater than \$300.

Using equation (2) we can calculate the expected surplus value for the tuber example.

$$E(X) = 1.00(\$100) + 0.75(\$100) + 0.25(\$100) = \$200.$$

Note that this calculation is based on one minus the cumulative distribution function. Using the formula for the area of a rectangle, the surplus value corresponds to the shaded areas in Figure 3-8.

Once again, we have calculated the same estimated surplus value using a different formula. It is simply interpreted as the expected surplus value per trip for the population.

In actual applications, the number of observations for any given dollar amount is generally small due to budgetary restrictions on the choice of a sample size and the wide distribution of surplus values that can occur. To estimate the cumulative distribution, given this data limitation, we use a logit equation which corresponds to a logistic distribution (see Hanneman, 1984). The logit function is fitted to the data using maximum likelihood procedures, and the estimated logit equation represents a continuous cumulative distribution function. The calculation of expected surplus values follows the calculation outlined by equation (1) and the result (surplus value per trip) is the shaded area in Figure 3-9, which simply corresponds to the shaded area in Figure 3-8, the surplus value for a discrete distribution.

Summary

The research procedures outlined here describe a two-stage approach to analyze the effects of different Glen Canyon Dam releases on downstream recreational experiences. In the first stage, attribute surveys are used to identify the important, flow-sensitive characteristics (attributes). The results of these analyses were used to construct descriptions of the recreational experiences under different flows (flow scenarios) or changes in an environmental parameter (such as the number and size of beaches available for camping). These flow scenarios were then evaluated by recreationists in the second stage, the contingent-valuation surveys.

Figure 3-8

Relationship Between Tuber Surplus Values and Answering No to a Dichotomous-Choice CV Question

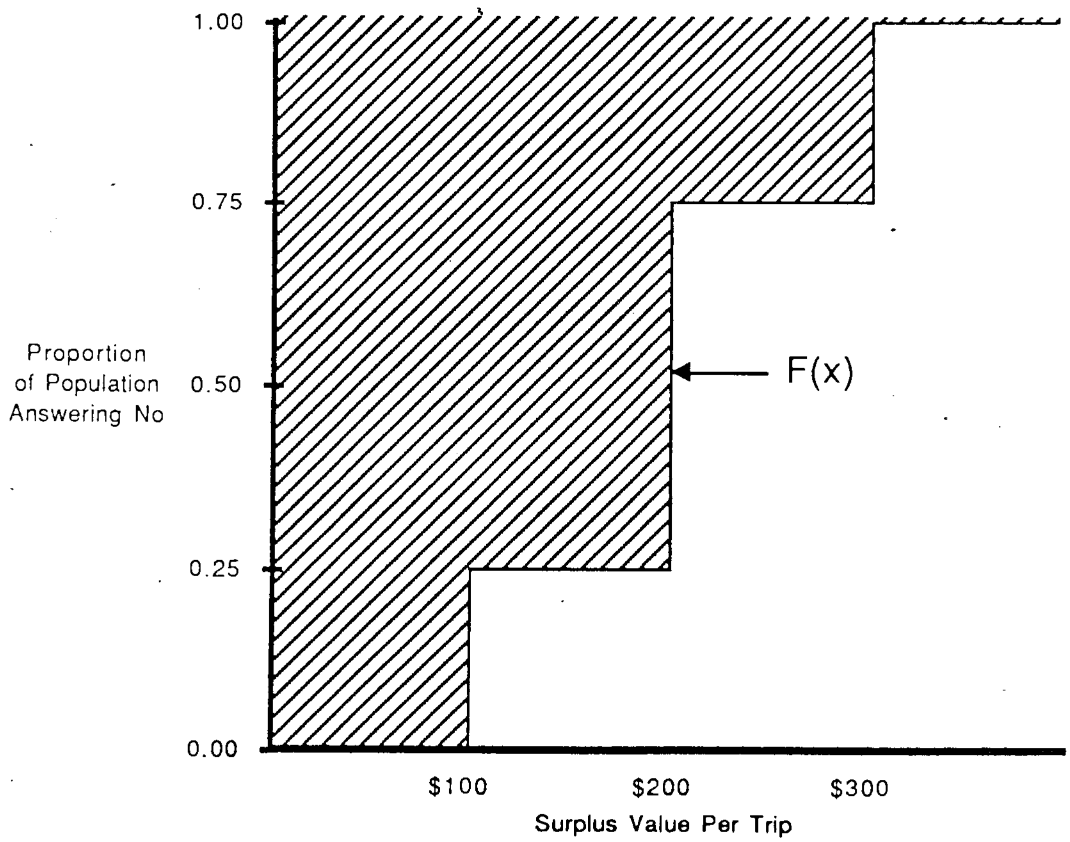
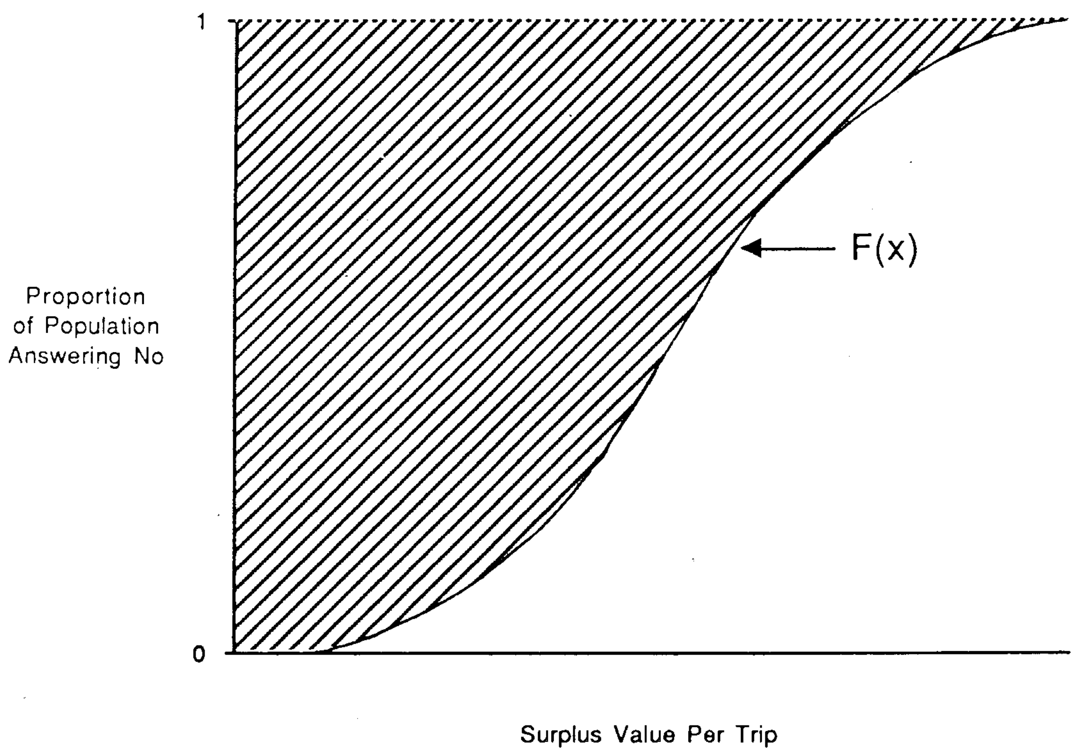


Figure 3-9

Cumulative Distribution Function for a Continuous Distribution of Surplus Values



This two-stage process utilizing respondents' evaluations of flow scenarios was required because few respondents experienced the necessary variation in flow conditions during the course of their recreational experience. Most respondents did not have sufficient experience with the different conditions to allow a reliable assessment based on data from their actual trips.

Hopefully, the discussion so far has clarified how CV is done, including how questions are designed and how values are calculated. At this point, attention will turn to the broader issue of reporting the empirical results from the surveys.

In the case of white-water boating, results of the attribute and CV surveys were supplemented by the guide and trip leader survey results. We will begin the white-water boating analysis by examining the guide and trip leader results.

CHAPTER 4

SURVEY OF WHITE-WATER RAFT TRIP COMMERCIAL GUIDES AND PRIVATE TRIP LEADERS

Introduction

Commercial white-water guides and private trip leaders are experts on the impacts of different Glen Canyon Dam releases on white-water raft trips. Unlike most commercial or private trip passengers, they have experienced a variety of river conditions and, especially for the commercial guides, have directly experienced a variety of different flow conditions on Grand Canyon white-water boating trips. The purpose of surveying guides and trip leaders was to identify their flow preferences and their perceptions of the impacts of different Glen Canyon Dam releases.

In this chapter we first discuss the role of commercial guides and private trip leaders during white-water boating trips. Next, the sampling and survey procedures are explained. The results of the survey and their implications for this study are then discussed.

Background

Approximately 80 percent of the Grand Canyon white-water user days during a typical year occur on commercial trips. Twenty-one licensed rafting companies (outfitters) are authorized to operate trips on the Colorado River in Grand Canyon National Park. Commercial trip passengers contract with an outfitter to provide a boat, other rafting equipment, food, and a guide. Commercial trips use both oar and motor-powered rafts and typically run from 3-4 days for a motor trip covering only the upper stretch of the river from Lee's Ferry to Phantom Ranch, to 20 days for an oar-powered trip that covers the full 250 river miles through Grand Canyon National Park. The National Park Service (NPS) maintains a roster of qualified Grand Canyon white-water raft trip guides that is updated annually. Each outfitter employs a staff of such guides who lead oar trips from April through October, and motor trips from May through September. In addition, a pool of qualified free-lance guides who do not work for any one outfitter are available to outfitters as needed.

The remaining 20 percent of the recreational user days are allocated to "do-it-yourself" or private party trips for which individuals furnish their own boats, rafting equipment, food, and guides or boat operators. Individuals must apply for a private permit, and permits are awarded in the order in which applications are received. Currently, there is a waiting list of approximately 3-4 years for private permits.

To help the National Park Service advise applicants of the types of equipment and skill that are appropriate for a Grand Canyon trip, individuals applying for a private permit are required to list the most experienced white-water boater who will be on the trip. These individuals were considered, for our purposes, to be trip leaders, even if the use permits were not issued in their names.

Commercial guides and private trip leaders are of particular interest in this study because they have the most first-hand experience with white-water boating under a variety of conditions, and can provide accurate and detailed views on the impacts of different Glen Canyon flows on white-water raft trips in the Grand Canyon.

Survey Procedures

Sampling. A sample of commercial guides was selected from the National Park Service's file of qualified guides, and representing guides currently employed by an outfitter, active free-lance guides, and guides who were not currently leading trips but had been active in one or more rafting seasons since 1982. One hundred-ninety commercial guides were randomly selected from the 450 names in the NPS guide file.

Private trip leaders were selected from 1985 NPS trip launch records which identified the trip leader (most experienced boat operator) from each of the private trips scheduled to launch during 1985. A total of 195 private trip leaders were selected from the approximately 223 private parties that received permits to raft the Colorado River through the Grand Canyon during the 1985 season. Thus, a total of 385 guides and trip leaders were included in the sample.

Response Rate. The first contact with commercial guides and private trip leaders in the sample occurred in December, 1985. Completed questionnaires were received from 288 guides, 75 percent of the total sample. Private trip leaders were slightly more likely to return a completed questionnaire (78 percent) than commercial guides (72 percent). Fifteen of the questionnaires were returned as undeliverable.

The response rate as a percent of all deliverable surveys is 78 percent (see Table 4-1). The analyses contained in this report are derived from 286 completed questionnaires: 134 completed by commercial guides and 152 completed by private trip leaders.[1/]

1/ Five surveys were received after the analysis of responses for this survey was completed. While these are included in the response rates for Table 4-1, they are not included in the results reported here.

Table 4-1. Commercial Guide and Private Trip Leader Survey Response Rate

Surveys	Percent of All Surveys	Percent of Deliverable Surveys*
Completed Surveys	75%	78%
Undeliverable Surveys	4	--
Surveys Not Returned	17	18
Refusals	4	4
TOTAL	100%	100%

* As noted in the text, 15 questionnaires were returned as undeliverable. Thus, the percentages in this column are computed from a sample size of 370 rather than 385.

Guide Survey Results

The primary objectives of this survey were two-fold. First, the survey provided data on guides' perceptions of the minimum and maximum flow levels for safely conducting Grand Canyon white-water boating trips, the flow levels which maximize passenger enjoyment, and the range of daily fluctuations in flows that they could tolerate without undue difficulties for themselves or passengers. Second, respondents were asked to describe the impacts that different Glen Canyon Dam release patterns have on white-water trips and the steps that they would take to "buffer" these impacts so that passengers receive a high quality recreational experience. Different questionnaires were sent to commercial guides and private trip leaders to take into account some of the differences between these two groups (see Appendices A and B).

The data from this survey were used to provide a description of the context in which Grand Canyon white-water boating trips take place that can be used to aid in the interpretation of responses to the questions in the white-water boater attribute and CV surveys. Results were also used in the design of the white-water boaters' contingent-valuation survey, especially in the construction of the alternative flow scenarios which passengers were asked to evaluate.

It will be helpful in presenting the results from the guide survey to distinguish between commercial guides who lead motorized raft trips and those who lead oar trips. Thus, in reporting the results, we will classify respondents as being a commercial motor guide a commercial oar guide or a private trip leader. Only a few of the private trips use motor-powered boats, so for this survey all private trip leaders were presumed to be giving responses for oar-powered boats. These distinctions are useful for drawing contrasts between the ways guides from these different types of trips responded to specific questions in the survey.

Evaluation of Constant Flow Levels. Respondents' evaluations of constant flow levels between 2,000 cfs and 80,000 cfs on a qualitative scale ranging from very unsatisfactory, to very satisfactory, followed a bell-shaped curve. Responses were similar across the three groups of guides (commercial motor, commercial oar, and private trip leaders). As shown in Figure 4-1, all three groups rated constant flow levels below 5,000 cfs as very unsatisfactory. At 10,000 cfs, respondents' ratings of the constant flow levels crossed the neutral line, and ratings peaked at flow levels between 20,000 and 25,000 cfs. Above these optimum flows, ratings decline and cross the neutral line again at about 40,000 cfs.

We also asked respondents to state the specific constant flow level that they would prefer as a commercial guide or private trip leader. Commercial motor guides reported a mean flow level of 20,622 cfs, while commercial oar guides and private trip leaders reported slightly higher mean flow levels of 26,180 and 25,158 cfs, respectively (see Table 4-2). These findings correspond closely to the optimum flow levels displayed for the qualitative rating scales in Figure 4-1.

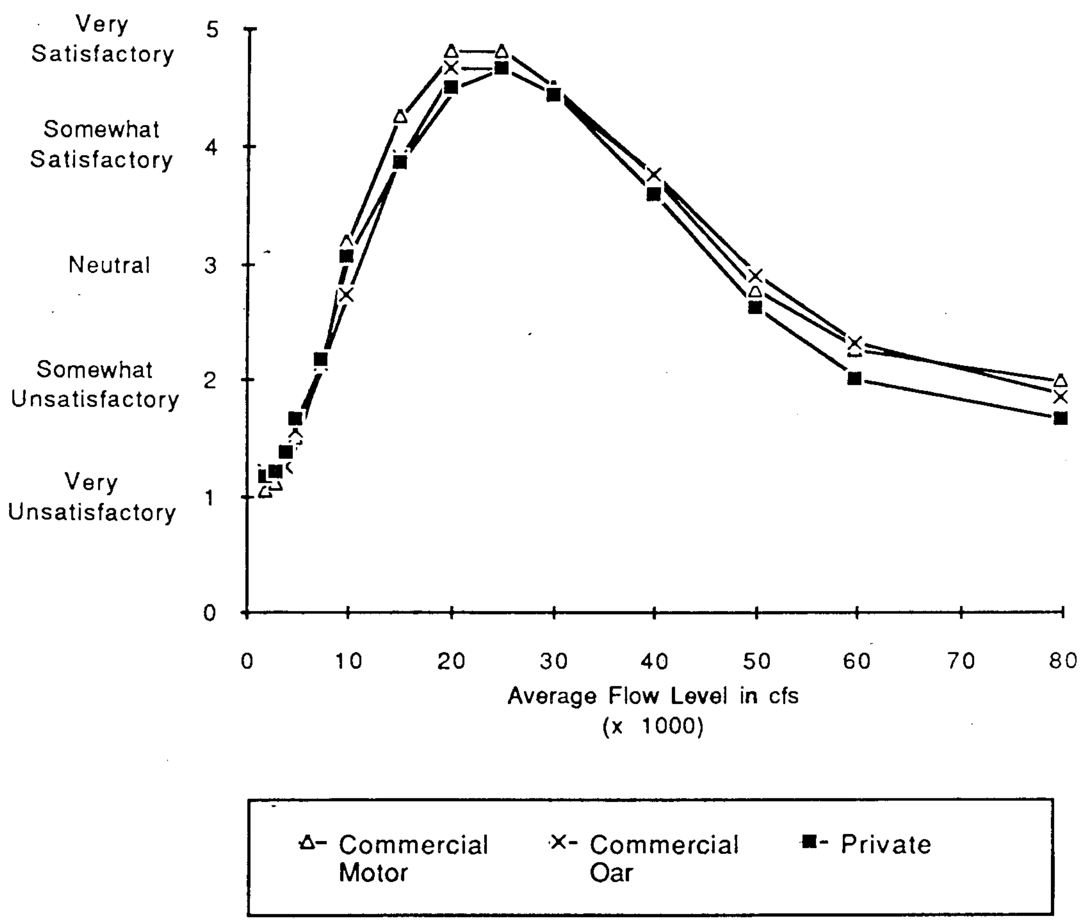
Table 4-2. Preferred Constant Flow Levels

Flow	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Preferred constant flow:			
Mean	20,622 cfs[a*]	26,180 cfs[b]	25,158 cfs[b]
Standard Deviation	6,096	10,583	7,515
Sample Size	78	50	145

* Statistics sharing a common superscript <u>are not</u> statistically different at the 0.05 level. Statistics with different superscripts <u>are</u> statistically different at the 0.05. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents. For example, the two statistics above with a "b" in their superscripts are not statistically different from each other. However, they are both statistically different at the 0.05 level from the statistic with an "a" in the superscript.

Figure 4-1

Guides' Constant Flow Level Preference Ratings



In contrast to the optimum constant flow levels, the reported minimum constant flow level for safely running river trips with passengers ranged from 8,405 cfs for commercial guides on motor trips to 9,198 cfs for guides on commercial oar trips. Private trip leaders reported a minimum flow of 9,025 cfs. The minimum flow levels, reported in Table 4-3 were not statistically different across the three groups of respondents. About half of each group reported that the minimum constant flow level requirement was 10,000 cfs or more, and nearly all respondents reported a minimum flow requirement of 3,000 cfs or more for a safe trip. It is interesting to note that the average minimum flow levels correspond very closely to the flow levels at which the preference ratings cross the neutral line in Figure 4-1.

Table 4-3. Reported Minimum Constant Flow Levels for Running River Trips Safely with Passengers

Flow	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Minimum level:			
Mean	8,405 cfs	9,198 cfs	9,025 cfs
Standard Deviation	3,344	4,859	4,271
Sample Size	78	52	138
Percent with minimum level of 3,000 cfs or above	100[a*]	88[b]	97[a]
Percent with minimum level of 10,000 cfs or above	42	52	48

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

The mean maximum constant flow level reported by respondents for running rapids safely with passengers averaged 59,014 cfs for commercial motor trip guides, 54,910 cfs for commercial oar guides, and 47,210 cfs for private trip leaders (see Table 4-4). Private trip leaders appear to be more sensitive to very high flows than commercial guides. Forty-five percent of the private trip leaders reported that the maximum level at which rapids can be safely run with passengers is 40,000 cfs or below. Less than one-third of the commercial trip guides reported a maximum safe flow level of 40,000 cfs or below.

Table 4-4. Reported Maximum Constant Flow Level for Running River Trip Safely with Passengers

Flow	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Maximum flow			
Mean	59,014 cfs[a*]	54,910 cfs[a]	47,210 cfs[b]
Standard Deviation	25,292	23,635	16,306
Sample Size	69	50	131
Percent with maximum level of 30,000 cfs or less	9[a]	12[ab]	20[b]
Percent with maximum level of 40,000 cfs or less	20[a]	32[ab]	45[b]

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Effect of Constant Flows on Attributes of a White-Water Trip. Increases or decreases in constant flows can affect how a guide manages his or her boat and runs the overall trip. For example, at very high flow levels guides may be more likely to scout major rapids before running them. At relatively low flows guides may ask passengers to break camp early so that they can stay on schedule. Given these considerations, we asked guides to report how they would adapt to differing constant flows.

Rapids are an important attribute of white-water boating trips which are affected by flows. Constant daily flows affect trip procedures at major rapids differently for commercial motor, commercial oar and private trips (see Figure 4-2). Most commercial oar guides report stopping to scout the major rapids no matter what the flow level. In contrast, commercial motor guides were more likely to report stopping to scout major rapids at low flows below 10,000 cfs and at high flows above 50,000 cfs. Private trip leaders were most likely to scout rapids at moderately high flow levels of 25,000 to 35,000 cfs. Guides and trip leaders were also more likely to have passengers walk around major rapids at flows of 10,000 cfs or less and at flows above 35,000 cfs (see Figure 4-3). Commercial oar passengers were the group most likely to walk around rapids at all flow levels.

Flow levels can also affect the trip schedule. For example, at low flows, boat operators may row or run the motor more often to stay on schedule. As shown in Figure 4-4, commercial guides are more likely than private trip leaders to attempt to compensate for the speed of the current at high or low constant flows. Nearly 9 out of 10 commercial guides reported rowing or motoring more at flows of 10,000 cfs or lower, while at high flows (35,000 cfs and above) about 3 out of 4 commercial guides reported motoring or rowing less.

Stops at attraction sites and time for hiking in side canyons are important attributes of white-water trips. A serious implication of low flows is the possibility that both commercial and private trip passengers may have to miss one or more attraction sites because of the additional time needed on the river that is needed to maintain a trip schedule. Nearly all guides indicated that certain low constant flow levels would prohibit stops at certain attraction sites (see Table 4-5). The minimum flow levels at which white-water boating trips would not have time for stops at all of their typically scheduled attraction sites ranged from 8,746 cfs for commercial motor trips to slightly more than 10,000 cfs for both types of oar power trips. It is also shown in Table 4-5 that constant high flows in the 30,000 cfs range would allow extra time for scheduled attraction sites or stops at additional attraction sites.

Similarly, flows can affect the availability and access to campsites, another important attribute of white-water boating trips. As reported in Table 4-6, most guides feel that flow levels do affect the availability of, and access to campsites. Flow levels at which it would be difficult to get to campsites on time are similar to those reported as affecting the time available for attraction sites and hiking side canyons. In addition, all three groups of guides indicate that at flow levels above 41,000 cfs, the size and availability of campsites becomes limited due to high water.

Figure 4-2

Proportion of Respondents Who Reported Stopping to Scout Major Rapids at Constant Flows

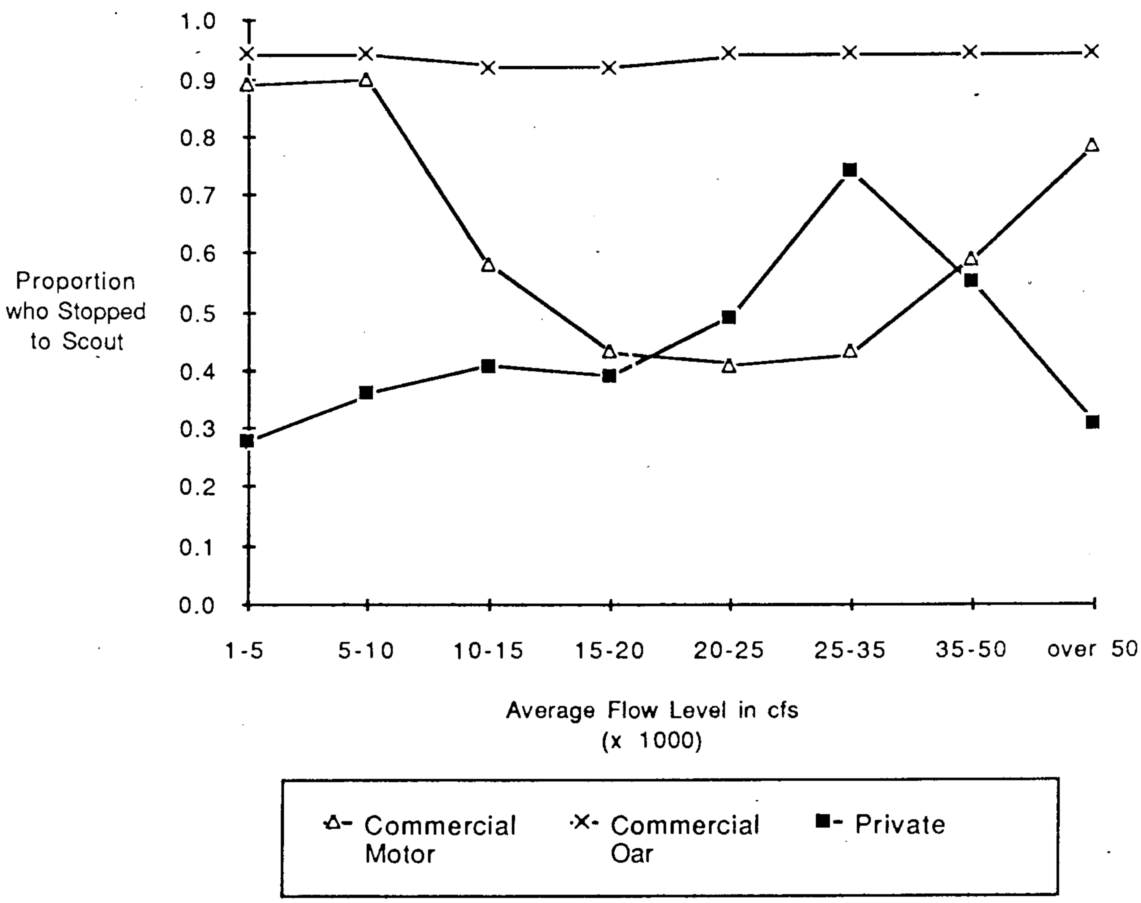


Figure 4-3

Proportion of Respondents Who Have Passengers Walk Around Rapids at Constant Flows

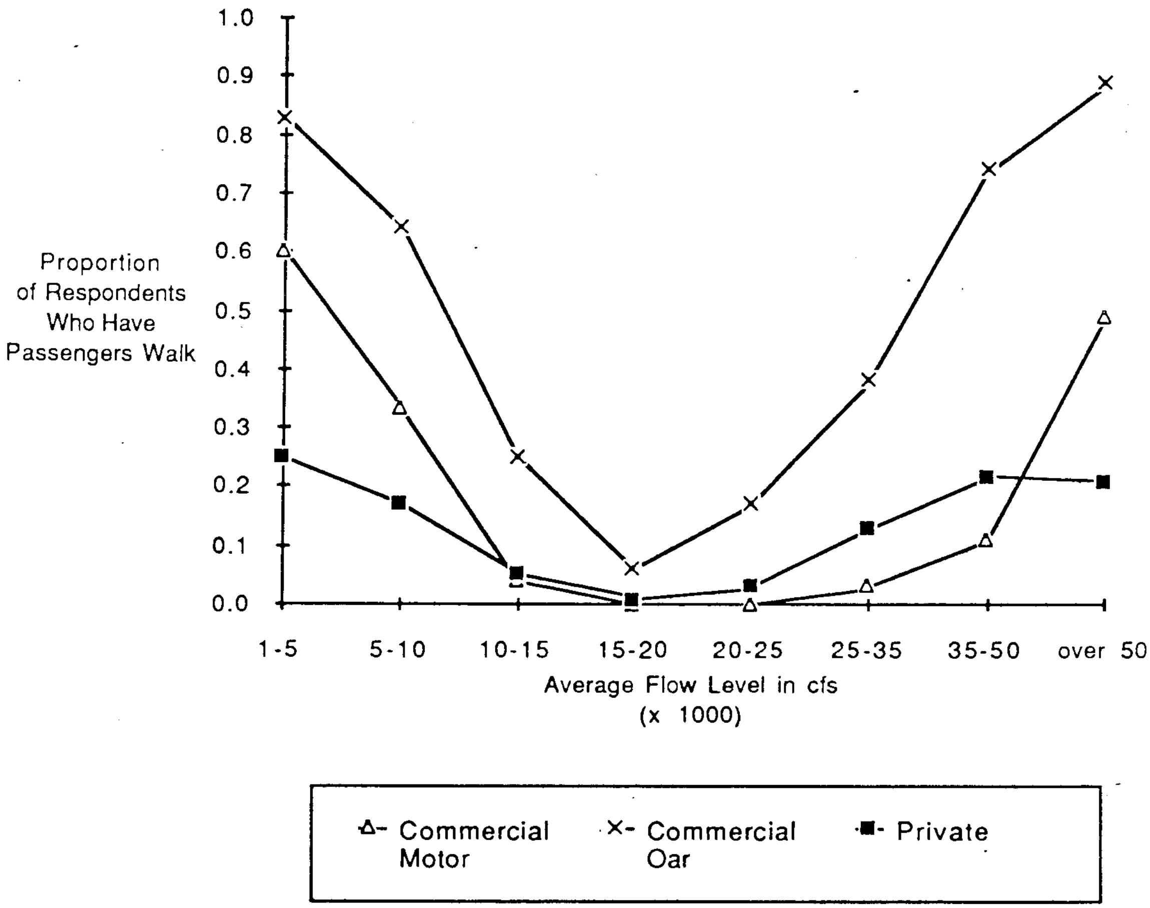


Figure 4-4

Proportion of Respondents Who Run Motor or Row More or Less Than Usual to Compensate for the River Current at Constant Flows

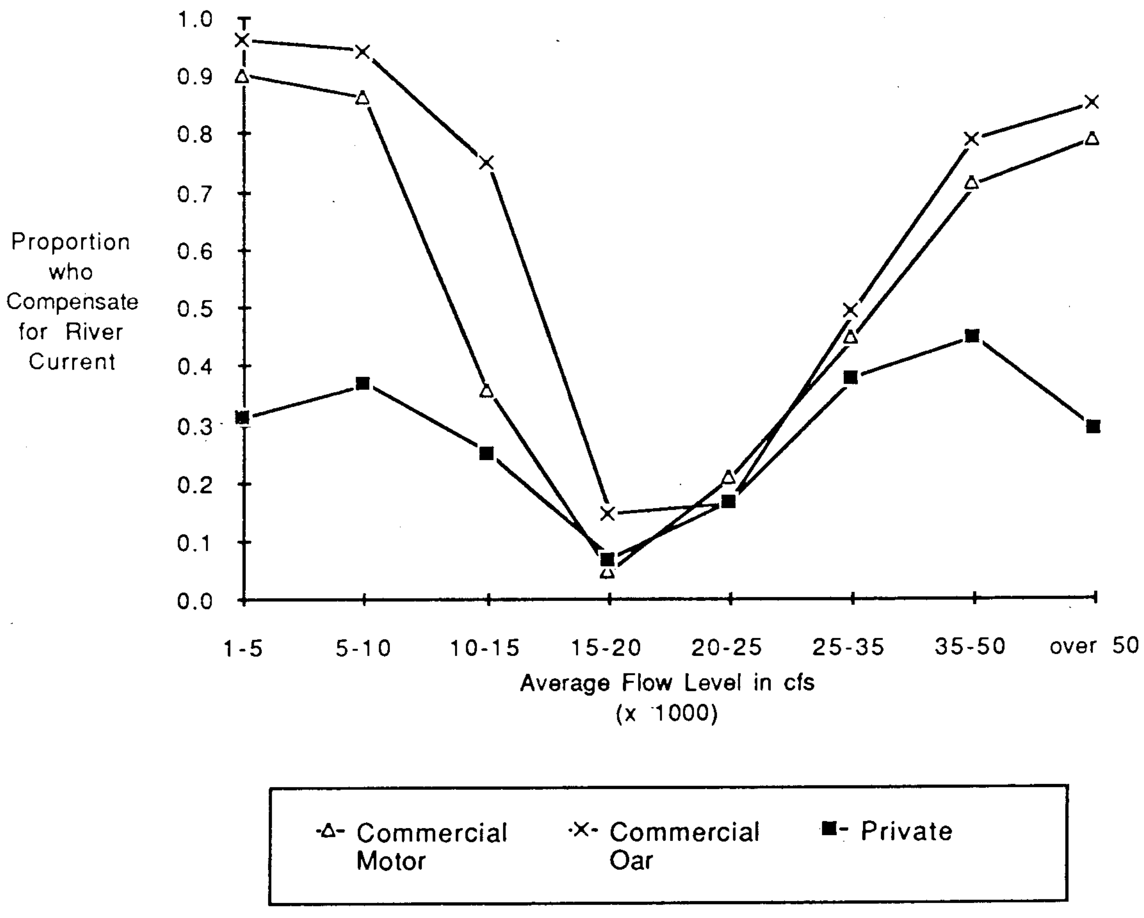


Table 4-5. Constant Flow Level Requirements for Use and Access to Attraction Sites

Flow	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Percent who feel that certain flow levels cause problems with use and access	87%[ab*]	96%[a]	85%[b]
Mean constant flow below which there would not be time for certain attraction sites	8,746 cfs[a]	10,398 cfs[b]	10,156 cfs[b]
Standard Deviation	3,237	4,285	4,176
Sample Size	63	49	115
Mean constant flow above which there would be extra time for attraction sites	29,312 cfs	32,896 cfs	30,441 cfs
Standard Deviation	11,103	10,133	9,392
Sample Size	64	48	110

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Table 4-6. Constant Flow Level Requirements for Access and Availability of Campsites

Flow	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Percent who feel that certain flow levels cause problems with access and use	80%[a*]	96%[b]	86%[ab]
Mean constant flow below which getting to camp on time is a problem	8,125 cfs[a]	9,298 cfs[ab]	10,025 cfs[b]
Standard Deviation	3,221	3,983	4,642
Sample Size	56	47	109
Mean constant flow above which campsites are limited	41,017 cfs	44,500 cfs	41,375 cfs
Standard Deviation	13,640	13,902	13,671
Sample Size	58	46	112

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Evaluation of Daily Fluctuations in Flow Level. Prior to the 1983 boating season, daily fluctuations in flow levels were common, often ranging from 3,000 to 28,000 cfs in a 24-hour period. During the last three boating seasons, however, a steady high flow of 25,000 cfs or more has been the most common flow level during the peak summer boating season. Consequently, not all of the commercial guides or private trip leaders have experienced daily fluctuations in flow levels. Two measures of experience were used to identify those respondents who were qualified to report on the effects of daily fluctuations. Respondents who said they could accurately describe fluctuations and who reported having actually experienced daily fluctuations of 15,000 cfs or more, were asked to evaluate the effects of large daily fluctuations.

The reported mean tolerable daily change in flow level ranged from about 3,000 cfs at average daily flow levels of 5,000 - 9,000 cfs to more than 8,000 cfs at average daily high flow levels of 32,000 cfs and above (Table 4-7). There were no significant differences in reported tolerances of daily flow level fluctuations between the three groups. As the average daily flow level increases, the reported tolerable range of daily changes also increases, indicating that at very low flow levels, even small fluctuations make a difference in the ability to run a white-water raft trip.

Table 4-7. Reported Mean Tolerable Daily Changes in Flow Levels for Those Who Have Experienced Daily Fluctuations of at Least 15,000 cfs in the Grand Canyon

Flow	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
5,000-9,000 cfs			
Mean daily change	3,231 cfs	3,412 cfs	2,428 cfs
Standard deviation	2,320	3,180	2,233
Sample size	52	34	45
9,000 - 16,000 cfs			
Mean daily change	4,706	4,786	3,936
Standard deviation	2,094	2,311	2,693
Sample size	52	35	47
16,000 - 32,000 cfs			
Mean daily change	7,192	6,708	6,410
Standard deviation	3,404	2,812	3,679
Sample size	52	36	50
32,000 cfs and above			
Mean daily change	9,760	7,903	8,612
Standard deviation	5,375	2,917	6,470
Sample size	52	36	49

The tolerable levels of daily fluctuations reported in Table 4-7 may represent a "wish" rather than an indication of the largest daily fluctuations that could actually be tolerated. Data from informal interviews and focus groups discussions with commercial guides suggest that the predictability of the fluctuations, rather than the range of the daily fluctuation, is the key factor in coping with daily fluctuations. Evaluations of different flow scenarios later in this chapter also support this conclusion.

Effect of Daily Fluctuations on Attributes of White-Water Trips. To gauge the impact of daily fluctuations on trip procedures, respondents were given the following hypothetical flow release pattern to consider:

> **Assume that flow levels were varying from a low of 3,000 cfs to a high of 25,000 cfs each day (or within a 24-hour period). Under these flow conditions, which of the following would you be likely to do?**

Over 60 percent of the commercial oar guides and private trip leaders indicated that it was very likely they would stop to scout major rapids more often. Commercial motor guides were less likely to indicate this (Table 4-8). About half of the respondents in each group reported they would very likely have to camp above a major rapid to wait for the water to rise.

Table 4-8. Impact of Daily Fluctuations in Flow Level on Procedures at Major Rapids

Procedure	Proportion Citing Procedure		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Stop to scout rapids more:			
Very likely	46%[a*]	62%[ab]	65%[b]
Somewhat likely	40	33	27
Not at all likely	14	5	8
Camp above a major rapids to wait for the water to rise:			
Very likely	51%	46%	54%
Somewhat likely	40	42	34
Not at all likely	9	12	12

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Daily fluctuations appear to have the greatest impact on campsite selection and the management of rafts at campsites (Table 4-9). Most of the respondents, especially commercial guides, indicated that they would select only certain campsites that offered protection against water level changes. More than 90 percent of the respondents in each group reported that they would have to check boat moorings during the night to see if the boat needed to be moved under the daily fluctuations described.

Table 4-9. Impact of Daily Fluctuations in Flows on Campsite Selection and Use

Procedure	Proportion Citing Procedure		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Check on boat moorings during the evening	95%	92%	98%
Select certain campsites to provide protection against rising water	91[a*]	94[a]	80[b]
Spend less time in camp	33[a]	56[b]	33[a]
Make camp earlier in the day	5[a]	12[ab]	17[b]

* Statistics sharing a common superscript <u>are not</u> statistically different at the 0.05 level. Statistics with different superscripts <u>are</u> statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Daily fluctuations in flows might also affect the itinerary of three out of four commercial and private trips. Almost three-fourths of the guides and trip leaders reported they would be likely to change their trip itinerary under the flow release pattern described above in order to reach certain points at a good time. Respondents reported that, if anything, they would spend <u>less</u> time rather than <u>more</u> time at scheduled attractions sites due to fluctuating flows (Table 4-10).

Table 4-10. Impact of Daily Fluctuations in Flows on Trip Itineraries

Procedure	Proportion Citing Procedure		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Change trip itinerary	74%*	75%	69%
Spend less time at attractions	42	43	37
Spend more time at attractions	5	12	6

* Statistics sharing a common superscript <u>are not</u> statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Preference Ratings of Four Flow Release Scenarios. GCES researchers were given five different flow regimes to evaluate. Each is an example of a particular type of flow release pattern that satisfies the legal requirements for releases from Glen Canyon Dam. For white-water boating, nearly all of which occurs during the months of May through October, two of the scenarios are identical, so respondents were asked to evaluate only four scenarios.

The first scenario, Scenario A, represents a <u>constant daily flow</u> without any fluctuations in the water levels. This scenario was described to the guides as follows:

> **There would be no daily fluctuations, but flows would change from one month to the next. Flows during May, June, July and August would be 10,000, 10,400, 12,750, and 14,400 cfs respectively, with no daily fluctuations. The rest of the year, flows would range from 8,300 cfs to 14,600 cfs, again with no daily fluctuations.**

Scenario B represents a <u>combination</u> of <u>constant daily flows</u> during the peak rafting season and <u>daily fluctuations</u> in the flow level during the remainder of the year. The scenario description is as follows:

> **Flows would be constant at 25,000 cfs during June, July, and August. During the rest of the year, daily flows could range from 1,000 to 33,500 cfs.**

Scenario C features severe daily fluctuations throughout the year with the minimum flow level being somewhat higher (3,000 vs. 1,000 cfs) during the prime rafting months of June, July, and August. This scenario was described in the following manner:

> **Flows would vary by day, season, and month. During June, July, and August, daily flows could range from 3,000 to 33,500 cfs with a major peak at 3:00 p.m. During the rest of the year, daily flows could range from 1,000 to 33,500 cfs.**

The final scenario, Scenario D, is comparable to Scenario C in that fluctuations in daily flows would be the norm throughout the year, but the daily fluctuations would be moderate throughout the entire year. The scenario description is:

> **Flows could vary by day, season, and month. Throughout the year, daily flows could range from 8,000 to 25,000 cfs. During the summer there would be a major peak around 3:00 p.m.**

The guides gave Scenarios D and A the highest mean rankings when they ranked all four scenarios in order of their preference (Table 4-11). Scenario D was the most preferred by the commercial oar and private trip leaders, while Scenarios D and A received equal mean ranking scores from the commercial motor guides.

Respondents were also asked to evaluate the acceptability of each scenario on a five point scale ranging from completely acceptable to completely unacceptable. The other points on the scale were somewhat acceptable, neutral, and somewhat unacceptable. Scenarios D and A were the least likely to be rated as unacceptable by respondents in each of the three groups (Table 4-12). Scenario D was rated as "Somewhat or Completely Unacceptable" by about one-third of the commercial oar guides and private trip leader respondents, and less than 20 percent of the commercial motor trip guides. The most unacceptable scenario (C) was rated as "Somewhat or Completely Unacceptable" by about 9 out of 10 respondents in each of the three groups. The rankings reported in Table 4-12 correspond closely to the overall mean rankings presented in Table 4-11.

Table 4-11. Mean Ranking of the Four Flow Scenarios

Scenario	Mean Rankings*		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
D (moderate daily fluctuations)	1.9[a**]	1.9[b]	1.9[ab]
A (constant daily flows)	1.9[a]	2.3[b]	2.1[ab]
B (combination flow pattern)	2.3	2.2	2.3
C (large daily fluctuations)	3.8	3.7	3.7

* A score of 1 was given to the most preferred scenario, while a score of 4 was given to the least preferred scenario. The mean rankings were computed averaging the rankings each group of respondents assigned to a scenario.

** Statistics sharing a common superscript <u>are</u> <u>not</u> statistically different at the 0.05 level. Statistics with different superscripts <u>are</u> statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Table 4-12. Percent Ranking Four Scenarios as Unacceptable

Scenario	Proportion of Respondents*		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
D (moderate daily changes)	16%[a**]	33%[b]	34%[b]
A (constant daily flows)	25[a]	44[b]	33[ab]
B (less severe daily changes)	59	54	53
C (severe daily changes)	91	89	93

* Percent ranking scenario as somewhat or completely unacceptable on a five-point scale that also included categories of "neutral," and "somewhat" or "completely acceptable".

** Statistics sharing a common superscript <u>are</u> <u>not</u> statistically different at the 0.05 level. Statistics with different superscripts <u>are</u> statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Evaluation of Scenarios. To better understand the guides' preference ratings of the four flow scenarios, they were given a list of potential problems and asked to indicate which problems were relevant to each scenario. Evaluations for each of the scenarios are reported in the order in which scenarios are ranked, with the most favorable scenario (Scenario D - moderate daily changes) described first.

Potential problems with Scenario D tended to focus on the daily fluctuations in the flow level. Fluctuations at camp, difficulty mooring boats, unpredictable flows and difficulty planning the trip schedule were the potential problems most often noted with this scenario (Table 4-13). Commercial motor trip guides were somewhat less likely than commercial oar guides or private trip leaders to view these as potential problems with Scenario D.

Table 4-13. Potential Problems with Scenario D (Moderate Daily Changes)

Problem	Proportion Citing a Problem		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Fluctuations at camp problematic	72%*	76%$_b$	72%
Difficulty mooring boats	37^{a}	54^{ab}	58^{b}
Flow is too unpredictable	38	50	50
Difficult to plan schedule	27^{a}	43^{ab}	46^{b}
Problems running rapids	20^{a}	39^{b}	29^{ab}
Lowest flows are too low	18^{a}	39^{b}	30^{b}
Unable to avoid other parties	19	24	17
Inadequate flow levels	18	22	16
No flexibility in running trip	15	20	19
Not enough time for attractions	14	20	20
Too much time on the river	8	17	15
Not enough challenge in rapids	0^{a}	4^{ab}	8^{b}

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Evaluations of Scenario A for the months of May through August indicate that potential problems focus on the relatively low flow level (constant daily flows range from 10,000 to 14,400 cfs) during the major portion of the rafting season (Table 4-14). Not enough time for stops at attraction sites, inadequate flows, and too much time on the river were cited as potential problems with this scenario by a substantial portion of commercial oar guides and private trip leaders. Again, commercial motor guides were somewhat less likely to cite each of these as potential problems, probably due to their ability to use the motor to make up time.

Table 4-14. Potential Problems with Scenario A (Constant Daily Flows) During May through August

Problem	Proportion Citing a Problem		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Not enough time for attractions	28% ^{a*}	54% ^{b}	41% ^{b}
Inadequate flow levels	16 ^{a}	48 ^{b}	36 ^{b}
Lowest flows are too low	19 ^{a}	48 ^{b}	31 ^{c}
Too much time on the river	24 ^{a}	39 ^{ab}	40 ^{b}
Unable to avoid other parties	26 ^{ab}	37 ^{a}	21 ^{b}
No flexibility in running trip	20 ^{a}	43 ^{b}	26 ^{a}
Problems running rapids	19	32	23
Difficult to plan schedule	10 ^{a}	30 ^{b}	17 ^{a}
Not enough challenge in rapids	11 ^{a}	19 ^{ab}	26 ^{b}
Difficulty mooring boats	6	6	5

* Statistics sharing a common superscript <u>are not</u> statistically different at the 0.05 level. Statistics with different superscripts <u>are</u> statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

For Scenario B, there would be constant daily flows of 25,000 cfs from June through August, but during the remainder of the year, flows could fluctuate daily between 1,000 and 31,500 cfs. For the June through August period with constant daily flows of 25,000 cfs, <u>no potential problems were indicated by more than 11 percent of the respondents from any of the three groups</u> (Table 4-15).

Table 4-15. Potential Problems with Scenario B (Combination Flow Pattern) During June through August

Problem	Proportion Citing a Problem		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Not enough challenge in rapids	11%*	4%	4%
Unable to avoid other parties	9	7	5
Problems running rapids	1	6	2
Difficulty mooring boats	1	4	1
Difficult to plan schedule	1	2	0
Too much time on the river	1	2	0
No flexibility in running trip	0	2	0
Inadequate flow levels	0	0	1
Lowest flows are too low	0	0	1
Not enough time for attractions	0	0	0

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

For the September through May time period, however, respondents indicated that there would be a substantial number of problems associated with daily fluctuations from 1,000 to 31,500 cfs. More than three out of four respondents indicated that flow levels would be too unpredictable, fluctuations would cause problems at camp, the lowest flow levels would be too low, and running rapids would be a problem under this scenario (Table 4-16). Respondents also indicated difficulty in mooring boats, inadequate flow levels, and the amount of time they would have to spend on the river would be problems during the off-season under Scenario B. For problems related to timing of stops or flexibility in running the trip, commercial motor guides were less likely to indicate that the severe daily fluctuations would cause problems, again, probably due to the ability to use the motor.

Table 4-16. Potential Problems with Scenario B (Less Severe Daily Changes) During September through May

Problem	Proportion Citing a Problem		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Flow is too unpredictable	80%[a]*	93%[b]	91%[b]
Lowest flows are too low	84	85	90
Fluctuations at camp problematic	76[a]	94[b]	83[a]
Problems running rapids	72	74	74
Inadequate flow levels	76[a]	57[b]	73[a]
Difficulty mooring boats	53[a]	80[b]	64[a]
Difficult to plan schedule	49[a]	67[b]	68[b]
Not enough time for attractions	43	48	41
Too much time on the river	38	54	45
No flexibility in running trip	30[a]	48[b]	32[a]
Unable to avoid other parties	19	20	19
Not enough challenge in rapids	1[a]	6[a]	21[b]

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Respondents did not feel that the less severe daily fluctuations during the months of June through August for Scenario C (a range of 3,000 to 31,500 cfs) would significantly alleviate the potential problems with this flow scenario. Indications of potential problems for the two different seasons were nearly identical. Table 4-17 presents the potential problems indicated for the June through August season, the months with the highest use level for white-water trips. Responses for September through May followed a similar pattern with slightly higher proportions of each group reporting potential problems. Respondents were most concerned about the effects of the fluctuations on camps and their impacts on mooring boats and running rapids. The low flows under Scenario C would also create problems for raft trips in planning their stops and daily itineraries.

Table 4-17. Potential Problems with Scenario C (Severe Daily Changes) During June through August

Problem	Proportion Citing a Problem		
	Commercial Motor Guides	Commercial Oar Guides	Private Trip Leaders
Fluctuations at camp problematic	85%	91%	84%
Flow is too unpredictable	80	91	85
Lowest flows are too low	72	72	74
Difficulty mooring boats	59^{a*}	81^{b}	68^{ab}
Problems running rapids	66	74	68
Difficult to plan schedule	60	74	66
Inadequate flow levels	59	57	56
No flexibility in running trip	44	43	38
Not enough time for attractions	34^{ab}	50^{a}	32^{b}
Unable to avoid other parties	32^{ab}	44^{a}	25^{b}
Too much time on the river	29	43	36
Not enough challenge in rapids	9^{a}	6^{a}	19^{b}

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Summary

The optimal flow levels reported by the commercial guides and private trip leaders are in the 20,000 to 25,000 cfs range. The mean minimum flow level for running rapids safely with passengers ranged from 8,400 cfs for commercial motor guides to 9,200 cfs for private trip leaders, while the mean maximum safe flow level ranged from 47,000 cfs for private trip leaders to 59,000 cfs for commercial motor guides. Private trip leaders reported the smallest range of "safe" flow levels, while commercial motor guides reported the largest.

Considering all aspects, flows of 20,000 to 30,000 cfs appear to be optimal for Grand Canyon commercial white-water guides and private trip leaders. These are the flows at which guides and trip leaders reported they are least likely to scout rapids, have passengers walk around major rapids, run the motor, and row more often. At these flow levels campsites are plentiful and there is ample time for side canyon hikes and stops at attraction sites.

Respondents who had experienced daily fluctuations reported that the largest tolerable daily fluctuation in flow levels is about 3,000 cfs with daily flows of 5,000 to 9,000 cfs, and about 8,000 to 9,000 cfs at higher daily flows averaging 32,000 cfs or more. With a release pattern involving large daily fluctuations, guides indicated they would scout rapids more often, seek out certain protected campsites, and change their usual itinerary, including less time at scheduled attraction sites.

Of the four different flow scenarios outlined by the GCES research team, the most preferred was one featuring moderate daily fluctuations in flow levels between 8,000 and 25,000 cfs. This scenario was slightly more preferred than one featuring moderately low constant daily flows of 8,300 cfs to 14,600 cfs. The two least preferred scenarios were a combination flow release pattern featuring constant daily flows of 25,000 cfs during June through August, and daily fluctuations from 1,000 - 31,500 cfs during September through May, and a scenario featuring large daily fluctuations throughout the entire year. It should be noted, however, that the constant daily flow of 25,000 cfs during June through August under the combination flow scenario (B) was evaluated most favorably by all three groups. If these constant daily flows had been extended to include May through September, this scenario would have been clearly ranked as most preferred by all three groups of respondents.

In evaluating the four flow scenarios, guides focused on two primary criteria: the range of daily fluctuations in flow level and the lower bound of the average daily flow level during the boating season of May through October. Both large daily fluctuations in flow levels and low constant flows were viewed as problematic for running rapids, selecting campsites and mooring boats, keeping the trip on schedule, and allowing time for scheduled attraction sites. These problems were reported to be alleviated by less severe daily fluctuations and higher average daily flows.

CHAPTER 5

WHITE-WATER BOATER SURVEYS AND RESULTS

Introduction

In this chapter the focus shifts from guides and trip leaders to white-water trip passengers. The results of the white-water boater attribute and contingent-valuation (CV) surveys are presented. First, white-water boating on the Colorado River is briefly reviewed to provide the reader with a perspective for this activity. Sampling procedures and results of the attribute survey are reviewed next. These results identify the important attributes of the Grand Canyon white-water boating experience, and specify those important attributes that are affected by different releases from Glen Canyon Dam. This is followed by the results of the CV survey and respondents' evaluations of white-water boating experiences at different flows. Respondents' actual trip surplus values, and surplus values based on responses to six different flow scenarios and an environmental impact scenario are presented and discussed. Flow value functions are then derived.

Background

The history of running the Colorado River in the Grand Canyon can be traced back to 1869, when John Wesley Powell led the first expedition down the Colorado River through what is now Grand Canyon National Park. Powell's first expedition, consisting of eight other crew members (none of them experienced boatmen) and four wooden boats, actually launched on the Green River in Wyoming. By the time they reached Lee's Ferry, the starting point for today's Grand Canyon white-water boating trips, they had already been on the river for more than 70 days, travelling nearly 600 miles (Crumbo, 1981).

Powell's interests were primarily scientific. Subsequent river runners were more likely to be trappers, hunters, miners, or adventurers than scientists. A variety of different river runners and different types of crafts ran the Colorado River through the Grand Canyon in the following years, but even as late as 1950, only about 100 people took the trip (Lavender, 1985).

The first commercial river trips began in 1938, organized by Norman Nevills, whose Mexican Hat Expeditions was the first commercial rafting company to operate in the Grand Canyon National Park. The first motorized trip was conducted in 1949, and, in the 1950's, army surplus neoprene rafts were introduced as a means to carry a large number of passengers on a single boat (Stevens, 1983).

Today, white-water boating in the Grand Canyon is a $12 million dollar a year industry, due in part to the construction of the Glen Canyon Dam (Ridgeway, 1984). Prior to the construction of the dam, river flows, were dependent upon runoff from snow melting in the Rocky Mountains, and they varied greatly from low flows of 1,600 cfs to peak flows approaching 120,000 cfs in the late spring and early summer. Today, with operation of Glen Canyon Dam, river flows typically occur in a much narrower range, from 3,000 cfs to 40,000 cfs, and show less seasonal variation than in pre-dam times. Rafting occurs during all months of the year, although the great majority of commercial and private raft trips take place in the months of May through October.

As noted in the preceding chapter, twenty-one companies currently have permits to conduct commercial raft trips in Grand Canyon National Park. Each year, approximately 15,000 commercial and private boaters run the river. Since 1981, restrictions on the number of white-water boaters have been set by the National Park Service as a response to rapidly increasing use levels (use had increased from 547 people per year in 1965 to 16,428 people in 1972) (Shelby, 1981). Current use restrictions set the number of user days at 115,500 for commercial trips and 54,450 for private parties. Motorized trips are currently allowed to launch from mid-May through mid-September. The season for private and commercial oar-powered trips is longer.

Commercial white-water boating trips vary on several different criteria: the size and type of craft; the length of the trip, both in miles covered and in number of days on the river; and the means of powering the boat. Boats range from 37-foot G-rigs, consisting of three smaller rafts lashed together, to single smaller (14-18 foot) rafts. Power for the larger rafts are supplied by outboard motors while smaller boats are typically powered by oar. Trips range from a 3-4 day motor trip from Lee's Ferry to Phantom Ranch, a distance of approximately 88 river miles, to an oar powered trip traversing the entire 225 mile stretch of river to Diamond Creek, lasting nearly three weeks.

Private (non-commercial) trips running the Colorado River through the Grand Canyon typically consist of two or more small 18-foot rafts, although a wide variety of boats including kayaks and canoes often accompany private trips. Private trips average 14-18 days. Private permits are issued on a first-come, first-serve reservation basis. Currently, 223 private party permits are allocated each year, and applicants may have to wait as long as 3 years to receive one.

Attribute Survey Procedures

Sampling. The final attribute survey (see Appendix C) was sent to a random sample of commercial motor, commercial oar and private trip passengers selected from the NPS trip launch records for the 1982 and 1984 seasons (April 1 through November 30). Passengers were selected from three different time periods to ensure that a variety of flow levels were represented in the survey. The sampling design called for the selection of an equal number of passengers from each group who had experienced high flows (40,000 cfs or more), medium flows (10,000 - 40,000 cfs), and low flows (less than 10,000 cfs). The time periods for which passengers were sampled and corresponding flows are as follows:

May 4 - July 15, 1984	High Flow
July 24 - September 30, 1984	Medium Flow
May 1 - June 30, 1982	Low Flow

The proposed sampling design was to select approximately equal numbers of private boaters, commercial oar passengers, and commercial motor trip passengers. Commercial outfitters were sent a list of selected trip dates and asked to provide either names and addresses of specified passengers (selected at random) or the entire trip rosters. Commercial trip passengers' names and addresses were obtained from 19 of the 21 Grand Canyon commercial outfitters. In cases where the selected passenger number or the trip roster was not available, an alternative passenger or trip from a comparable flow level was substituted. Private trip rosters were obtained from NPS records of river trips during the 1982 and 1984 seasons. In cases where a selected private boater's address was not available from Park Service records or was insufficient for mailing a questionnaire, an individual from an alternate trip with a comparable flow level was selected.

In this way, 682 individuals were initially selected to participate in the study; 214 commercial motor passengers, 227 commercial oar passengers, and 227 private boaters. However, due to language differences and complications with return postage, individuals who did not reside in the U.S. were dropped from the sample (12 persons, 1.76 percent). Two other people selected notified us upon their receipt of the advance letter that they had not actually taken a rafting trip and were also removed from the sample. These modifications reduced the overall sample size to 668.

Response Rate. In March, 1985, the sample received their first mail contact informing them of the attribute survey. Completed questionnaires were received from 81 percent of the total sample (see Table 5-1).

Table 5-1. White-Water Boaters' Attribute Survey Response Rate

Surveys	Percent of Total	Percent of Deliverable Surveys*
Completed Surveys	81%	91%
Undeliverable	11	--
Surveys not returned	7	8
Refusals	1	1
TOTALS	100%	100%

* 77 surveys were returned as undeliverable. Thus the percentages in this column are computed from a sample of 591 rather than 668.

Overall, 77 surveys (11 percent) were returned as undeliverable. Thus, the response rate as a percent of deliverable surveys was 91 percent. The analyses contained in this report are derived from 532 returned surveys: 177 commercial oar passengers, 189 commercial motor passengers, and 166 private boaters.1/ Commercial motor passengers were slightly more likely to respond to the survey, although response rates for all groups were between 89 and 95 percent (Table 5-2). When undeliverable surveys are excluded, respondents from 1982 were just as likely to return a completed surveys as those from 1984 trips.

Table 5-2. White-Water Boater Attribute Survey Response Rates by Trip Type and Year*

Year	Commercial Oar Trip	Commercial Motor Trip	Private Trip
1982	88%	95%	86%
1984	90	94	92

* Response rates calculated as percentages of all deliverable surveys.

1/ Six additional surveys were returned after the data analyses were completed. While these six are included in the response rates reported in Table 5-1, they are not included in the results reported in the remainder of this text.

Attribute Survey Results

Trip Attributes. White-water boaters were first asked, in an open-ended question format, to report the attributes they felt would contribute most to an excellent or perfect Grand Canyon trip. Answers to this question are summarized in Table 5-3. Good weather, good social interaction, good guides, an unrushed pace (time for layovers and stops at attraction sites), and a wilderness experience were the attributes mentioned most often by the respondents as contributing to an excellent or perfect trip.

Table 5-3. Attributes that Contribute Most to An Excellent or Perfect Grand Canyon Raft Trip

Attribute	Proportion Citing Attribute		
	Commercial Oar	Commercial Motor	Private Boaters
Good weather	33%*	38%	34%
Good social interaction	22[a]	29[a]	51[b]
Good guides	44[a]	41[a]	10[b]
Unrushed pace/more layovers	29	27	26
Wilderness experience	27[ab]	19[a]	29[b]
Well conducted trip	16[a]	28[b]	30[b]
Good food	24[ab]	26[a]	17[b]
Good/exciting rapids	22[a]	20[ab]	13[b]
Being in the Grand Canyon	13[a]	26[b]	15[a]
No crowding	19[a]	11[b]	22[a]

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Among the attributes listed by 15 percent or more of all respondents, four are potentially affected by flow levels: time for layovers and stops at attraction sites, good/exciting rapids, a wilderness experience, and not feeling crowded. These four attributes are related to flow levels in a variety of ways. As reported in Chapter 4, commercial guides and private trip leaders report that the amount of time for stops at attraction sites, hiking side canyons, and layovers is significantly reduced at relatively low flows.

Rapids are also flow-related since a number of small to medium rapids become "washed out" at relatively high flows, while other larger rapids become more problematic and exciting to run. The feeling of being in a wilderness area can be affected by fluctuations in daily flows since changes in flow releases from the dam would have an obvious visible effect on the recreation environment. Finally, white-water boaters may feel more crowded at high flows because the number and size of beaches for camping are significantly reduced. In addition, during conditions of daily fluctuations in flows, boaters may become congregated above rapids as they wait for the water level to rise.

For these four potentially flow-sensitive attributes it is interesting to note that "good/exciting rapids" is somewhat less important to private boaters than it is to commercial passengers. On the other hand, enjoying "a wilderness experience" and "not feeling crowded" are less important attributes for commercial motor passengers. These findings would appear to be related to the types of trips taken by commercial passengers and private boaters and their expectations.

Respondents were also asked to identify the attributes they felt would contribute most to a poor Grand Canyon boating experience. A question with open-ended response categories was used once again, and the attributes cited most often were crowding and bad weather (see Table 5-4). Among the attributes identified by respondents, crowding, litter, unsafe conditions and low water levels are potentially affected by flows.

We have already addressed why "crowding" can be a flow-sensitive attribute. Litter can be related to flows in that high flows and fluctuating flows with a high upper bound have a tendency to "flush-out" the canyon, removing debris along the shore, at camping beaches, and at attraction sites. Flows affect safety primarily through their effect on the size of rapids, and the difficulty of running rapids. At high flows, as was previously noted, some rapids become washed out while others become more problematic to run. In addition, rapids which are washed out at high flows may be difficult to run at relatively low flows. "Low water", as revealed by the results of the guides survey, can affect the ability of trip leaders to keep the expeditions on schedule and it can also cause problems with mooring boats at campsites.

Table 5-4. Attributes that Contribute Most to A Poor Grand Canyon Raft Trip

Attribute	Proportion Citing Attribute		
	Commercial Oar	Commercial Motor	Private Boaters
Crowding	34%[ab*]	30%[a]	41%[b]
Bad Weather	35[a]	42[a]	25[b]
Poor guides	38[a]	31[a]	9[b]
Poor Social interaction	20[a]	25[ab]	33[b]
Litter	20	22	20
Unsafe conditions	7[a]	8[a]	31[b]
Low water level	14	16	14

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Since commercial trip passengers and private boaters generally have a limited amount of actual experience with different flow levels, respondents were also asked to rate a number of attributes of a Grand Canyon white-water raft trip specified by the researchers (Table 5-5).

The most important attributes in Table 5-5, as designated by the overall ratings, correspond closely to respondents' answers to the open-ended attribute questions. In addition, there is substantial agreement among the three types of boaters on the important attributes of a Grand Canyon raft trip. Of the ten attributes listed, five may be affected by flow levels: being in a natural setting, stopping at side canyons or creeks, hiking in side canyons, large rapids, and observing wildlife.

Table 5-5. Importance Ratings of Grand Canyon Raft Trip Attributes

Attribute	Overall Ratings*		
	Commercial Oar	Commercial Motor	Private Boaters
Being in a natural setting	3.0^{a**}	2.9^{a}	3.0^{b}
Stopping at side canyons or creeks	2.9	2.8	2.9
Relaxing, getting away from it all	2.7	2.7	2.8
Hiking in the side canyons	2.7^{ab}	2.7^{a}	2.8^{b}
Confidence in my guide or trip leader	2.7^{a}	2.8^{a}	2.5^{b}
Large rapids	2.7	2.7	2.6
Observing flora, fauna, and geology	2.7^{a}	2.7^{ab}	2.7^{b}
Being on the Colorado River	2.6	2.6	2.6
Learning about the history of the Grand Canyon	2.5^{a}	2.7^{b}	2.6^{ab}
Seeing Wildlife	2.5	2.5	2.6

* Overall ratings are calculated by assigning values of 1 through 3 to responses of "not important" through "very important", respectively, and computing weighted averages.

** Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Attributes of Rapids. We presumed at the outset of this study that rapids would be an important attribute. Thus, we wanted to identify the specific aspects of rapids that could increase or decrease respondents' enjoyment of their trips. To accomplish this objective, respondents were provided with a list of 12 attributes that are specific to rapids and they were asked to indicate whether each one "increased," "decreased," or "had no effect" on their enjoyment. The five most important and the five least important attributes from this list are reported in Table 5-6. The numbers reported here record the percentages of respondents indicating that the specific attribute could either increase or decrease their enjoyment of a Grand Canyon white-water trip.

Table 5-6. Important Attributes of Rapids Increasing or Decreasing Enjoyment by User Group

Attribute	Proportion Citing Attribute		
	Commercial Oar	Commercial Motor	Private Boaters
Increasing Enjoyment:			
Rapid with large waves	90%[*]	95%	94%
Roller coaster ride	91[a]	95[ab]	98[b]
Long rapid	92	94	89
Large number of rapids	91	92	87
Learning how to "read" rapids from the guide or trip leader	87[a]	85[a]	76[b]
Decreasing Enjoyment:			
Having to walk around a rapid	81%	83%	83%
Waiting at a rapid for other trips to run it	48	51	47
Fear of falling out of boat and being in the water for long time	45[a]	33[b]	50[a]
Concern about damage to personal equipment	36[a]	26[b]	51[c]
Rocks sticking out of water	31	25	29

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

The relative rankings of both positive and negative attributes are quite consistent across the three groups of respondents. Large waves, a roller coaster ride through rapids, and length and the number of rapids were cited most often as increasing enjoyment. Having to walk around a rapid was noted most often as decreasing enjoyment.

Private boaters were less likely to indicate that learning how to "read" rapids from a guide or trip leader increased their enjoyment. Private boaters were more concerned, however, with the chances of falling out of the boat than were commercial motor passengers, and they were also more concerned about damage to personal equipment than were commercial passengers.

Attributes of Campsites. Campsites were also presumed to be an important attribute. To identify the aspects of campsites that are important, respondents were asked to evaluate a list of 26 campsite-specific attributes and to indicate whether they felt each attribute was "very important," "somewhat important," "not important," or "had no effect." The ten most important attributes of campsites are listed in Table 5-7. The relative rankings of attributes are similar across the three groups, and clean campsites and a natural appearance are the most important attributes.

Table 5-7. Rating of Attributes of Campsites

Attribute	Overall Ratings*		
	Commercial Oar	Commercial Motor	Private Boaters
Clean, unlittered campsites	3.0	3.0	3.0
Natural appearance	2.9	2.9	2.8
Scenic view	2.7[a]**	2.7[a]	2.5[b]
Isolation from other groups	2.7[a]	2.6[b]	2.6[ab]
Side canyon for hiking	2.6[a]	2.5[b]	2.7[a]
Few flies or mosquitoes	2.6	2.6	2.5
Nearness to river	2.5	2.5	2.5
Clear water in side canyons	2.5	2.5	2.4
Place to dock boats	2.4[a]	2.4[a]	2.6[b]
Flat area for sleeping	2.5	2.4	2.5

* Overall ratings are calculated by assigning values of 1 through 3 to responses of "not important" through "very important," respectively and computing weighted averages.

** Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Sensitivity of Selected Attributes to Flows. The sensitivity of four selected attributes to flow levels were also examined by grouping respondents according to the average flow levels they actually experienced. The average flow levels were categorized as: low (less than 16,000 cfs), medium (16,000 to 32,000 cfs), and high (greater than 32,000 cfs). Responses to items measuring walking around rapids, amount of time for hiking and attraction sites, reported crowding on the river, and reported crowding at campsites were examined by trip type and flow category. Commercial oar passengers were the most likely group to report having to walk around a rapid at any flow level, while commercial motor passengers were the least likely (Table 5-8). For commercial oar and private trip respondents, the probability of having to walk around a rapid increases as flow level increases. For commercial motor trip passengers, however, there is no relationship with flow level.

Table 5-8. Respondents Walking Around Rapids by Flow Level Experienced

Trip Type	Proportion of Respondents Walking Around Rapids		
	Low Flow	Medium Flow	High Flow
Commercial Oar	16%[a*]	36%[b]	47%[b]
Commercial Motor	3	0	0
Private Boater	5[a]	6[a]	26[b]

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Respondents' evaluations of the adequacy of time available for hiking side canyons and stopping at attraction sites were not affected by the average daily flow level experienced. Most commercial trip passengers felt they had enough time, but only 1 out of 2 private boaters felt they had enough time (Table 5-9). This is probably due, in part, to a difference in expectations since private boaters generally have more experience in the canyon and may be more aware of attraction sites and hiking opportunities than are commercial passengers.

Table 5-9. Amount of Time for Hiking and Attraction Sites

Response	Commercial Oar	Commercial Motor	Private Boaters
There was enough time	81%[a*]	69%[b]	52%[c]
There was not enough time	18[a]	30[b]	47[c]
There was too much time	1	1	1

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Respondents were also asked to indicate on a nine-point scale how crowded they felt the river was on their trip. Responses to this question are summarized in Table 5-10. Commercial motor and oar passengers' perceived level of crowding did not differ by flow levels. Private passengers, however, felt more crowded at low and high flows than at moderate flows.

Since crowding can manifest itself at camping beaches, especially at high flow levels, we also asked respondents whether they felt crowded at campsites during their trip. Responses to this question reveal that private passengers who experienced high flow levels were most likely to perceive crowding at campsites (Table 5-11).

Table 5-10. **Reported Crowding by Flow Level Experienced**

Level of Crowding	Proportion Feeling Crowded								
	Commercial Oar			Commercial Motor			Private Boaters		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Not at all crowded (1,2)	39%	33%	39%	44%	50%	45%	29%[a]	50%[b]	19%[c]
Slightly crowded (3,4)	37	40	47	40[a]	36[ab]	24[b]	35	30	33
Moderately crowded (5,6,7)	23[ab*]	27[a]	10[b]	15[a]	11[a]	31[b]	35[a]	18[b]	46[a]
Extremely crowded (8,9)	1	0	4	1	3	0	1	2	2
Mean Rating*	3.3	3.4	3.2	3.1	2.9	3.3	3.8[a]	3.0[b]	4.4[a]

* Mean ratings calculated by assigning values of 1 through 9 to responses of "Not at all crowded" through "Extremely crowded", respectively, and calculating a weighted average.

** Statistics sharing a common superscript <u>are</u> <u>not</u> statistically different at the 0.05 level. Statistics with different superscripts <u>are</u> statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Table 5-11. Reported Crowding at Campsites by Flow Level Experienced

	Proportion Feeling Crowded		
	Low Flow	Medium Flow	High Flow
Commercial Oar	30%	40%	39%
Commercial Motor	28	24	40
Private Boater	38[a]*	37[a]	70[b]

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Respondent Perceptions of Flow Levels. Given a choice of flow levels, about one-half of the respondents indicated they preferred the flow level to be about the same as it was during their trip. Examination of the responses of those who expressed a preference for a flow different than they actually experienced, however, reveals a pattern favoring medium flow levels (Table 5-12). That is, those experiencing a low flow were more likely to prefer higher flows, and the converse holds for those who experienced high flows. Those who experienced medium flows and expressed a preference for a different flow were evenly split regarding their preferences for a higher or lower flow.

With respect to fluctuations in daily flow levels, substantial fluctuations in excess of 12,700 cfs are required before nearly all respondents' reported noticing changes in the water level. Respondents' awareness of flow fluctuations are reported in Table 5-13. These responses are categorized by trip type and the level of fluctuation actually experienced. Overall, private boaters were the most sensitive to fluctuations and commercial motor passengers were the least sensitive.

Table 5-12. Flow Level Preferences by Flow Level Experienced

Preferred Flow	Proportion Preferring Specified Flow Level								
	Commercial Oar			Commercial Motor			Private Boaters		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Lower	0%[a*]	13%[b]	23%[b]	7%[a]	8%[a]	30%[b]	5%[a]	10%[a]	50%[b]
Same	47	56	53	50	52	35	49[ab]	66[b]	40[a]
Higher	36[a]	13[b]	6[b]	23	16	15	34[a]	12[b]	2[b]
Don't Know/Care	17	18	18	20	24	20	12	12	8

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Table 5-13. Respondents Reporting Awareness of Changes In Flow Level

	Average Daily Fluctuations Experienced		
	Less than 2,500 cfs	2,500-12,700 cfs	12,700 cfs or more
Commercial Oar	37%[a*]	65%[b]	85%[c]
Commercial Motor	18[a]	65[b]	79[b]
Private Boaters	59[a]	76[a]	98[b]

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

The majority of respondents felt that daily fluctuations in flow levels would make the river seem "somewhat less" or "much less" like a natural setting (Table 5-14), although nearly one in four respondents felt that fluctuations "would not have any effects," and 11 percent overall did not know what the effect would be. Private boaters were much more sensitive than commercial passengers to fluctuations, with nearly three out of four saying that fluctuations would make the setting seem less natural.

Contingent-Valuation Survey Procedures

Sampling. The White-Water Boaters' Contingent-Valuation Survey (see Appendices D and E) was sent to a sample of 598 individuals who took a Grand Canyon trip during the 1985 rafting season (February 26 through November 6). Names and addresses for these individuals were obtained from National Park Service launch records and commercial outfitters. The sample was stratified into three user groups: 1) passengers from commercial oar trips; 2) passengers from commercial motor trips; and 3) individuals who took private trips. Surveys were sent to 195 commercial oar passengers, 191 commercial motor passengers, and 212 private boaters.

Table 5-14. Evaluation of Effects of Daily Fluctuations on Perceptions of a Natural Setting

Evaluation of Fluctuations	Commercial Oar	Commercial Motor	Private Boaters
Much more like a natural setting	2%	3%	1%
Somewhat more like a natural setting	7	6	4
Wouldn't have any effect	24[ab*]	28[a]	19[b]
Somewhat less like a natural setting	25[a]	25[a]	22[b]
Much less like a natural setting	28[a]	22[a]	52[b]
Don't know	14[a]	16[a]	2[b]

* Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

The flow levels experienced by respondents for their 1985 trips are recorded in Table 5-15. The average flow levels for private boaters are somewhat lower than those of commercial passengers, due to the extended private rafting season, and the fact that a larger percentage of commercial passengers take their trips during the months of June through August when average flow levels are generally higher. The highest average daily flow level experienced by commercial passengers was 44,400 cfs and the low was 10,500 cfs. The comparable high and low flows for private boaters were 43,200 cfs and 10,700 cfs, respectively.

Table 5-15. Daily Flow Levels Experienced by Respondents to the Grand Canyon Boater Contingent-Valuation Survey

Flow	Commercial Passengers	Private Boaters
Average Flow	28,900 cfs	26,000 cfs
Average High Flow	31,600	29,200
Average Low Flow	25,200	21,800

Response Rate. The CV surveys were mailed out in May, 1986. Overall, 508 usable questionnaires were returned (87 percent of the total sample). Eleven additional questionnaires were returned but were not used because the respondents were under 18 years old. The response rate as a percent of all deliverable questionnaires was 91 percent (Table 5-16). The results presented in this report are based on the responses of 506 Grand Canyon boat trip passengers: 170 commercial oar passengers, 167 commercial motor passengers, and 169 private boaters.[2/]

Table 5-16. White-water Boater Contingent-Valuation Survey Response Rate

Surveys	Percent of All Surveys	Percent of Deliverable Surveys**
Completed surveys	87%	91%***
Undeliverable *	4	--
Not applicable	1	--
Surveys not returned	8	9
Refusals	0	0
TOTALS	100%	100%

* This includes 11 questionnaires returned but not included in the data analysis since the respondents were less than 18 years old.

** The percentages in this column are computed from a sample size of 560 rather than 598. The undeliverable and not applicable surveys have been excluded.

*** Two of these surveys were returned after the data analysis was completed.

Contingent-Valuation Survey Results

Actual Trip. Respondents spent a relatively large amount of money, on average, for their Grand Canyon white-water trips. Average reported total expenditures ranged from about $557 for individuals on private trips to roughly $1,406 for passengers on commercial trips.

2/ Two surveys were received after the data analyses for this report were completed. While these two are included in the response rates reported in Table 5-16, they are not included in the results reported in the remainder of this report.

These differences in total expenditures are primarily due to payments to commercial rafting companies and greater expenditures for transportation to the Grand Canyon on the part of commercial trip passengers.

Respondents also placed a substantial surplus value on their actual trip, above and beyond their actual expenditures. We found that surplus values vary with the average flow level experienced as well as type of trip (commercial or private).[3/] Commercial passenger surplus values for constant flows rise from $47 per trip at 1,000 cfs to a maximum of $898 at 33,000 cfs, and then decline to $732 at 45,000 cfs.[4/] Private boaters' constant flow surplus values follow a similar pattern, rising from $21 per trip at an average flow of 1,000 cfs to a maximum of $688 at 29,000 cfs, and then declining to $376 at 45,000 cfs. Thus, surplus values of commercial passengers are higher than those for private passengers at all constant flow levels (Figure 5-1).[5/] This is not surprising, however, since their actual expenditures per trip are also higher.

The magnitude of the difference between private boater and commercial passenger surplus values increases from $26 at 1,000 cfs to $356 at an average flow of 45,000 cfs.

The optimum flow level for commercial passengers, as indicated by surplus values, occurs at 33,000 cfs. This is 4,000 cfs higher than the optimum flow level for private boaters (29,000 cfs), and private boater surplus values decline faster at flow levels above their optimum than do those for commercial passengers. These results may be due to the fact that commercial passengers have a professional

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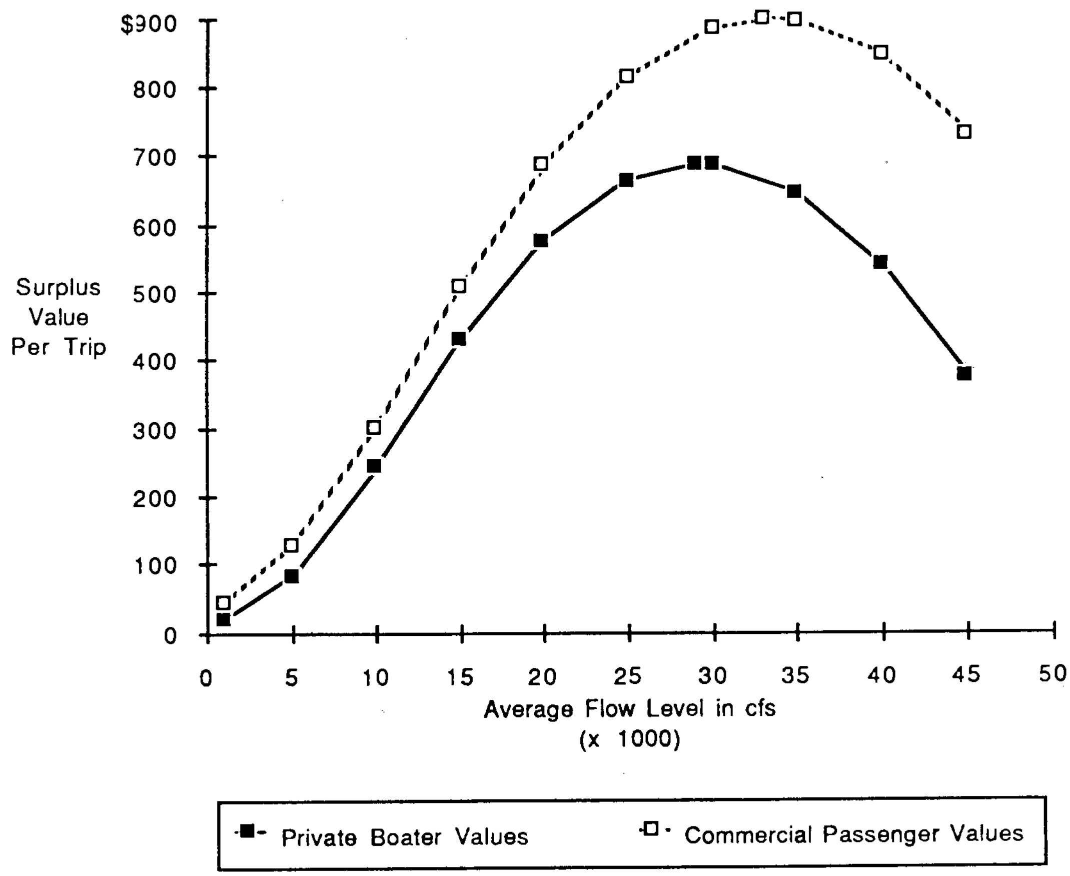
3/ The statistical results from the analysis of each of the contingent-valuation questions (for the actual trip and the seven scenarios) are reported in Appendix L.

4/ The average flow levels experienced by respondents for their actual trips ranged from 10,500 to 44,400 cfs. Thus, we extrapolated the flow value function for white-water boaters down to 1,000 cfs to cover the full range of constant flow levels the GCES research teams were asked to evaluate.

5/ The values plotted in Figure 5-1 and summarized above can be thought of as surplus values associated with constant flow levels. The average daily fluctuation experienced by respondents was 6,700 cfs, which is probably not readily noticeable to most white-water boaters. Only 12 percent of the respondents experiencing daily fluctuations in excess of 10,000 cfs, so we did not have a sufficient number of these types of observations to make any inferences about fluctuating flow surplus values from the actual trip data.

Figure 5-1

Relationship Between Surplus Values and Flow Levels for Respondents' Actual Trip ($ Per Trip)



guide who is familiar with the river and, as a result, they can enjoy the larger "roller coaster" ride through rapids at high flow levels without the concerns of handling a boat. Private boaters, on the other hand, may have to give more consideration to the problem of maneuvering their boats through rapids at higher flows since they typically do not have the experience with Grand Canyon boating that commercial guides do.

Several other types of variables were also examined to determine if they significantly affected actual trip surplus values. The type of boat used (motor raft, oar raft, paddle raft, kayak, or dory) did not affect surplus values. Private boater surplus values, however, were significantly reduced if they had to share beaches for camping or felt crowded on the river. These variables did not significantly affect surplus values for commercial passengers. This result could be due to differing expectations between these two groups.

For a full discussion of the variables analyzed in conjunction with the actual trip valuation question, the reader should refer to Appendix L.

Scenarios. Respondents were asked to evaluate a total of six different flow scenarios as well as one environmental impact scenario (see Table 5-17). As with the analysis for the actual trip valuation question, several variables were tested to determine if they had a statistically significant effect on surplus values. The size of the increase in trip expenses presented to respondents had a significant effect on surplus values at the 0.10 level or better in all seven cases. The variable representing actual trip expenditures had a significant effect at the 0.10 level in five of the seven cases and, once again, there was a positive relationship between expenditures and surplus values, a result that was unanticipated. We found no evidence of strategic bias or hypothetical bias in respondents' answers to the scenario valuation questions. A full description of the analyses of responses to the flow scenario CV questions is contained in Appendix L.

With so many scenarios, one concern was whether respondents' answers to the associated valuation questions might be affected by the order in which the scenarios were presented. Therefore, the sample was randomly split in half and each group received a different sequence of scenarios in their questionnaires. All questionnaires had the actual trip question first. Half then began with the 5,000 cfs constant flow scenario and moved up through successively higher flows with constant flows always preceding the corresponding fluctuating flows. For example, the 5,000 cfs constant flow scenario preceded the 5,000 cfs average flow with daily fluctuations scenario. The environmental impact scenario, which postulated a significant reduction in beaches over time, was the last scenario valued.

For the other group, the order of the scenarios was reversed, except that for purposes of scenario wording, the constant flow scenarios had to precede the corresponding fluctuating flow scenarios at each level. Statistical analysis showed no effect of the scenario order on surplus values.

The surplus values for each of the scenarios are summarized in Table 5-17. For low flows, large fluctuations around an average flow of 5,000 cfs significantly increased surplus values, relative to a constant flow, in the case of commercial passengers, but did not affect private boater values. At a moderate flow of 22,000 cfs, large daily fluctuations significantly reduced surplus values for both groups of respondents. A high constant flow of 40,000 cfs produced lower surplus values than moderate constant flows of 13,000 and 22,000 cfs, but were higher than those for a low constant flow of 5,000 cfs. Finally, a substantial reduction in the number of sand beaches for camping would substantially reduce surplus values, and only the 5,000 cfs scenarios recorded lower surplus values. We will briefly discuss each of these values.

Table 5-17. Estimated Scenario Surplus Values for White-Water Boaters ($ PER TRIP)

Scenario	Commercial Passengers	Private Boaters
5,000 cfs	$176	$233
5,000 cfs with fluctuations	226	241
13,000 cfs	488	504
22,000 cfs	602	525
22,000 cfs with fluctuations	467	384
40,000 cfs	439	434
Beaches reduced	413	377

Case 1 - Constant Flow of 5,000 cfs. This flow was described in the survey as follows:

> **At a constant flow of 5,000 cfs, the speed of the river is relatively slow, reducing time for side canyon visits and other attractions. Boaters must break camp early to stay on schedule. Although rapids are present at this low water level, the waves are smaller and do not produce the big "roller coaster" ride created by higher flows. Due to exposed rocks, some rapids may be so difficult that it is likely passengers would have to walk around them. However, camping opportunities are abundant with many large sandy beaches exposed.**

Over 90 percent of all respondents felt that this scenario represented a trip that would be worse than the one that they actually experienced (Table 5-18). This feeling is represented by the surplus values of $233 and $176 per trip that private boaters and commercial passengers, respectively, assigned to this scenario. These values are substantially less than the maximum surplus values for these two groups derived from the actual trip data.

Table 5-18. Rating of the 5,000 cfs Constant Flow Scenario Relative to Actual Trip

Rating	Proportion of Respondents Citing Rating	
	Commercial Passengers	Private Boaters
Better	0%	4%
About the Same	4	3
Worse	96	93

Case 2 - Average Flow of 5,000 cfs with Daily Fluctuations. The scenario description was as follows:

> **With flows fluctuating daily from 1,000 to 17,000 cfs, around an average daily flow of 5,000 cfs, most people are aware of changes in the water level. Trip speed is relatively slow, reducing time for side canyon visits, and boaters must break camp early to stay on schedule. Large sandy beaches are generally abundant, but boatmen must take care selecting mooring sites. Occasionally, due to low water in the morning, gear will have to be carried a long ways (perhaps**

> **across slippery rocks) to be loaded on the boats. Boatmen may have to wait above certain rapids for the water to rise, or hurry to get to a rapid before the water falls. Due to exposed rocks, some rapids may be so difficult that it is likely passengers would have to walk around them. At other rapids, however, higher flows may produce large waves and a bigger "roller coaster" ride than at a low constant flow.**

Respondents were first asked whether they would prefer a trip with low water and large daily fluctuations, as described above, or low water with small daily fluctuations. Given these two alternatives, private boaters were more likely to prefer low water with small fluctuations, while commercial passengers indicated a preference for low water with large fluctuations (Table 5-19). These findings appear to be consistent with the type of trips each group experienced. Commercial passengers do not need to be concerned with the management of a boat so that they may enjoy the large fluctuations at a low flow level because they can get a bigger "roller coaster" ride when rapids are reached at the high end of the fluctuation. On the other hand, private boaters must consider the effect that fluctuations have on their trip schedule and the care of their boat(s).

Table 5-19. Respondents' Preferences for Fluctuations at Low Flow Levels

Preference	Proportion of Respondents Stating Preference	
	Commercial Passengers	Private Boaters
Low water/small fluctuations	30%	49%
Low water/large fluctuations	60	42
Makes no difference	10	9

Commercial passengers' preferences for low water with large daily fluctuations relative to constant low flows is consistent with the surplus value they assigned to this scenario. The surplus value commercial passengers assigned to this scenario is $226 per trip. This is significantly different from the value of $176 they placed on the 5,000 cfs constant flow scenario. The surplus value for private boaters is $241 per trip, which is not statistically different from the surplus value reported for the 5,000 cfs constant flow scenario of $233 per trip.[6/]

Case 3 - Constant Flow of 13,000 cfs. In this scenario respondents evaluated the following experience:

> **At moderate water levels (around 13,000 cfs), the pace of the river is slightly faster than at low flows, leaving a little more time for hiking in side canyons and stops at attractions. Most boating groups will not have a problem staying on schedule. Rapids tend to have larger waves and provide a little more of a "roller coaster" ride than at low water. Passengers may have to walk around only a few rapids. Campsites are still large and plentiful.**

Most respondents indicated that this trip would be about the same or worse than their actual trip (Table 5-20). This result is not surprising given that 13,000 cfs is considerably below the flow level most respondents experienced as well as the optimum flow levels derived from the actual trip valuation data.

Table 5-20. Rating of The 13,000 cfs Constant Flow Scenario Relative to Actual Trip

Rating	Proportion of Respondents Citing Ratings: Commercial Passengers	Private Boaters
Better	15%	25%
About the Same	32	36
Worse	53	39

6/ The Chi-square statistics for these tests are 7.46 and 0.08, respectively, with two degrees of freedom. These statistics indicate that the null hypothesis of no difference can be rejected at the 0.10 level for commercial passengers, but cannot be rejected for private boaters.

The surplus values assigned to this scenario are $504 per trip for private boaters and $488 per trip for commercial passengers. These values are both significantly larger than the respective surplus values reported for the 5,000 cfs constant flow scenario.[7/]

Case 4 - Constant Flow of 22,000 cfs. Case 4 is another constant flow scenario which was described as follows:

> **At moderately high water levels (around 22,000 cfs), the pace of the river is faster than at lower flows, leaving more time for side canyons and stops at attractions. Boating groups do not have a problem staying on schedule. Rapids have larger waves and provide a bigger "roller coaster" ride than at moderate water. Only a few passengers choose to walk around some of the bigger rapids for their safety. Some potential campsites are under water in some areas of the canyon, but generally campsites are plentiful although a bit smaller in size.**

A majority of the respondents felt that a trip under these conditions would be about the same as the trip they actually experienced (Table 5-21). This is to be expected since this scenario comes the closest to describing the actual flow levels experienced by most of the respondents.

Table 5-21. Rating of The 22,000 cfs Constant Flow Scenario Relative to Actual Trip

Rating	Proportion of Respondents Citing Ratings	
	Commercial Passengers	Private Boaters
Better	22%	30%
About the Same	67	66
Worse	11	1

[7/] The Chi-square statistics for these tests are 88.42 for commercial passengers and 31.60 for private boater's with two degrees of freedom, indicating that the null hypothesis can be rejected at the 0.10 level.

Overall, private boaters assigned a surplus value of $525 per trip to this scenario, while the surplus value for commercial passengers is $602 per trip. The surplus value for commercial passengers is statistically larger than the respective value reported for the 13,000 cfs constant flow scenario of $488. The same comparison for private boaters did not reveal a significant difference in surplus values between the 13,000 cfs and 22,000 cfs constant flow scenario values.[8/]

Case 5 - Average Flow of 22,000 cfs With Fluctuations. Case 5 is similar to Case 4 except that fluctuations were introduced. This scenario was described in the following manner:

> **With large daily fluctuations from 10,000 cfs - 31,500 cfs, around an average daily flow of 22,000 cfs, most people are aware of water level changes. The boatmen will have to take more care in selecting mooring and camping sites. Due to low water levels in the morning, gear may have to be carried (perhaps across rocky areas) to be loaded on the boats.**
>
> **Boatmen may decide to wait above certain rapids for the water level to rise or may have to hurry to get to a certain rapid before the water level falls. In addition, some rapids may be difficult due to exposed rocks at low water levels and other rapids might be quite large at high water levels, and it is likely that passengers may have to walk around a few rapids. When the water is high or rising, however, the standing waves in some of the major rapids become larger, resulting in a bigger "roller coaster" ride.**

The majority of respondents, regardless of trip type, said they would prefer to experience moderately high water with small fluctuations rather than moderately high water with large fluctuations (Table 5-22).

8/ The Chi-square statistics for these tests are 8.08 and 0.90, respectively, with two degrees of freedom. These statistics indicate that the null hypothesis of no difference can be rejected at the 0.10 level for commercial passengers and cannot be rejected for private boaters.

Table 5-22. Respondents' Preferences for Fluctuations at Moderately High Flow Levels

Preference	Proportion of Respondents Citing Preference	
	Commercial Passengers	Private Boaters
Moderately high water/ small fluctuations	81%	89%
Moderately high water/ large fluctuations	11	7
Makes no difference	8	4

The surplus values for this scenario are $384 per trip for private boaters and $467 for commercial passengers. These values are both significantly lower than the respective surplus values reported for the 22,000 cfs constant flow scenario.[9]

Case 6 - Constant Flow of 40,000 cfs. Case 6, the final flow specific scenario respondents were asked to evaluate, was described in the following manner:

> **At high water levels (around 40,000 cfs), the current is fast. Trips are able to stop at additional side canyons and spend additional time at attraction sites. Fewer rapids are present, as some of the smaller rapids are "washed out." In other rapids, however, the waves are very large and some passengers, especially those on oar powered trips, face an increased likelihood of having to walk around one or more of the major rapids for their safety. Campsites become more scarce as sandbars and shore areas are flooded, and campsites are much smaller. In some areas of the Canyon, there is an increased chance of camping with or near other groups.**

9/ The Chi-square statistics for these tests are 7.59 for private boaters and 12.21 for commercial passengers, with 2 degrees of freedom, indicating that the null hypothesis of no difference can be rejected at the 0.10 level.

Most respondents felt that this scenario described a trip that would be about the same or worse than their actual experience (Table 5-23). This result is consistent with the previously reported findings in that 40,000 cfs is a higher flow level than most respondents experienced and is also higher than the optimum flows derived from the actual trip valuation data. The surplus values respondents assigned to this scenario, $343 per trip for private boaters and $439 for commercial passengers, reflect these feelings. The value for commercial passengers is significantly lower than the respective surplus value reported for the 22,000 cfs constant flow scenario. However, a statistically significant difference does not exist between the 22,000 and 40,000 cfs constant flow scenario values for private boaters.[10/]

Table 5-23. Rating of The 40,000 cfs Constant Flows Scenario Relative to Actual Trip

Rating	Proportion of Respondents Citing Rating: Commercial Passengers	Proportion of Respondents Citing Rating: Private Boaters
Better	7%	8%
About the Same	27	36
Worse	66	56

Change 1 - Beaches Reduced. This scenario is not anchored at a particular flow level but to the flow the respondent actually experienced. Respondents were asked to evaluate a scenario where the number of sand beaches available for camping are substantially reduced. The scenario description is as follows:

10/ The Chi-square statistics for these tests are 21.62 and 3.21, respectively, with 2 degrees of freedom. These results indicate that the null hypothesis of no difference can be rejected at the 0.10 level for commercial passengers and cannot be rejected for private boaters.

> **There are indications that certain types of flow patterns in the long run may reduce the number of sandy beaches in the Grand Canyon. At present, the area between Hance Rapids and Havasu has fewer beaches than other parts of the canyon. Trip leaders must plan schedules very closely to ensure a good campsite in this area. As beaches disappear, this careful planning would have to be extended to other parts of the canyon.**
>
> **This planning might mean missing some attraction sites to get to camp early or longer stops at some attraction sites. Fewer beaches would increase the likelihood of camping near other parties and perhaps sharing a beach with other parties. Some camps might have to be made in areas without any sand.**

Private boaters placed a surplus value of $377 per trip on this scenario and the value for commercial passengers is $413 per trip, indicating that a reduction in the number of beaches would substantially decrease the surplus value that boaters place on their Grand Canyon white-water trips. Only the constant flow and fluctuating flow scenarios at 5,000 cfs have lower surplus values.

Summary

The attribute survey revealed that several important attributes of Grand Canyon white-water trips are affected by flow levels: being in a natural setting, stopping at attraction sites and hiking side canyons, and rapids. Analysis of these attributes for respondents' actual trips reveal that these attributes are generally sensitive to release patterns from Glen Canyon Dam.

The optimum constant flow levels, according to the analysis of the actual trip data, occur at constant average daily flows of 29,000 and 33,000 cfs for private boaters and commercial passengers, respectively. The highest scenario surplus values, however, occur at a constant flow of 22,000 cfs. We believe this difference is simply due to the fact that we did not anchor a scenario in the flow range from 29,000 to 33,000 cfs. If we had selected a scenario which was anchored at an average flow of 31,000 cfs, we strongly suspect that this would have been the scenario with the highest surplus value.

Despite the fact that we did not select a scenario that was anchored at a moderately high flow, the surplus values for constant flow scenarios show a great deal of consistency when plotted against the actual trip surplus values. This comparison is done for commercial passengers in Figure 5-2 and for private boaters in Figure 5-3.[11/] The scenario values, for both groups of respondents, are somewhat higher than the actual trip values at flows below 15,000 to 20,000 cfs. At higher flows the direction of the difference is reversed. Given these graphic representations of the relationships between average flow levels and surplus values, one can see why we believe that a scenario anchored at a constant flow of 31,000 cfs may have resulted in the highest surplus value across all scenarios.

Only 12 percent of the respondents experienced daily fluctuations in flow levels in excess of 10,000 cfs. Thus, we did not have enough observations to draw any inferences about fluctuating flow surplus values from the actual trip data. The potential for this type of problem was anticipated in the study design and the scenarios were developed to describe Grand Canyon boating experiences under a wide range of flow regimes. From the analyses of responses to the scenario valuation questions, we found that fluctuations in daily flows significantly increase commercial passenger surplus values at a low average flow of 5,000 cfs, while private boater surplus values were unaffected by these same conditions. At a moderate flow of 22,000 cfs, however, fluctuations in daily flow levels significantly reduce surplus values for both commercial passengers and private boaters. The flow value functions for fluctuating flows are presented in Figure 5-4, and are derived by linear interpolation between the 5,000 and 22,000 cfs fluctuating flow scenarios. The functions are extended to 3,000 and 25,000 cfs to cover the full range of average flows that can occur with daily fluctuations in excess of 10,000 cfs.

Given the findings reported above, we would conclude that the Grand Canyon White-Water Boater Contingent-Valuation Survey was quite successful. The results are internally consistent and match well with the preferences expressed by white-water boaters in the earlier attribute survey, as well as the flow preferences of the commercial white-water guides and private trip leaders collected in a separate survey and summarized in the preceding chapter. The resulting surplus values, therefore, seem to be adequate for the next stage in the analysis, the evaluation of alternative annual flow regimes, reported in Chapter 8.

11/ The flow value functions for the scenarios were derived by linear interpolation between the 5,000 and 13,000 cfs, the 13,000 and 22,000 cfs, and the 22,000 and 40,000 cfs constant flow scenario values.

Figure 5-2

Commercial Boater Surplus Values for Constant Flow Scenarios and Actual Trip ($ Per Trip)

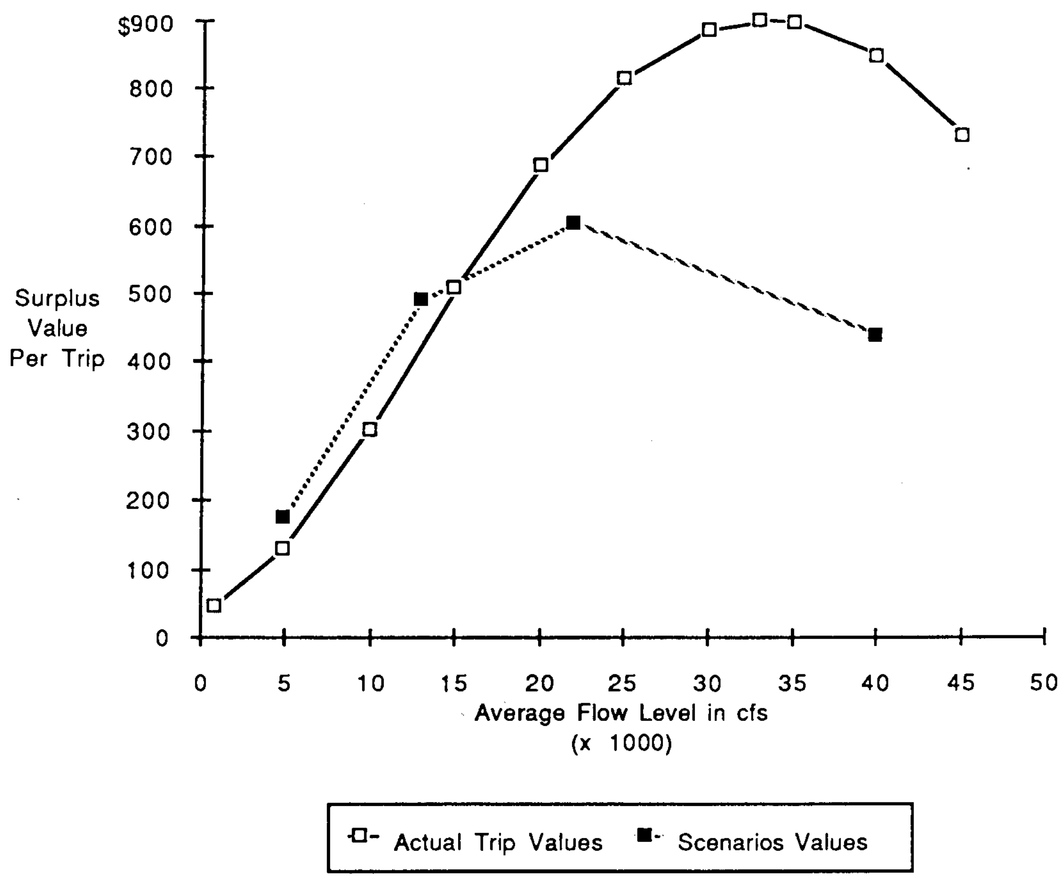


Figure 5-3

Private Boater Surplus Values for Constant Flow Scenarios and Actual Trip ($ Per Trip)

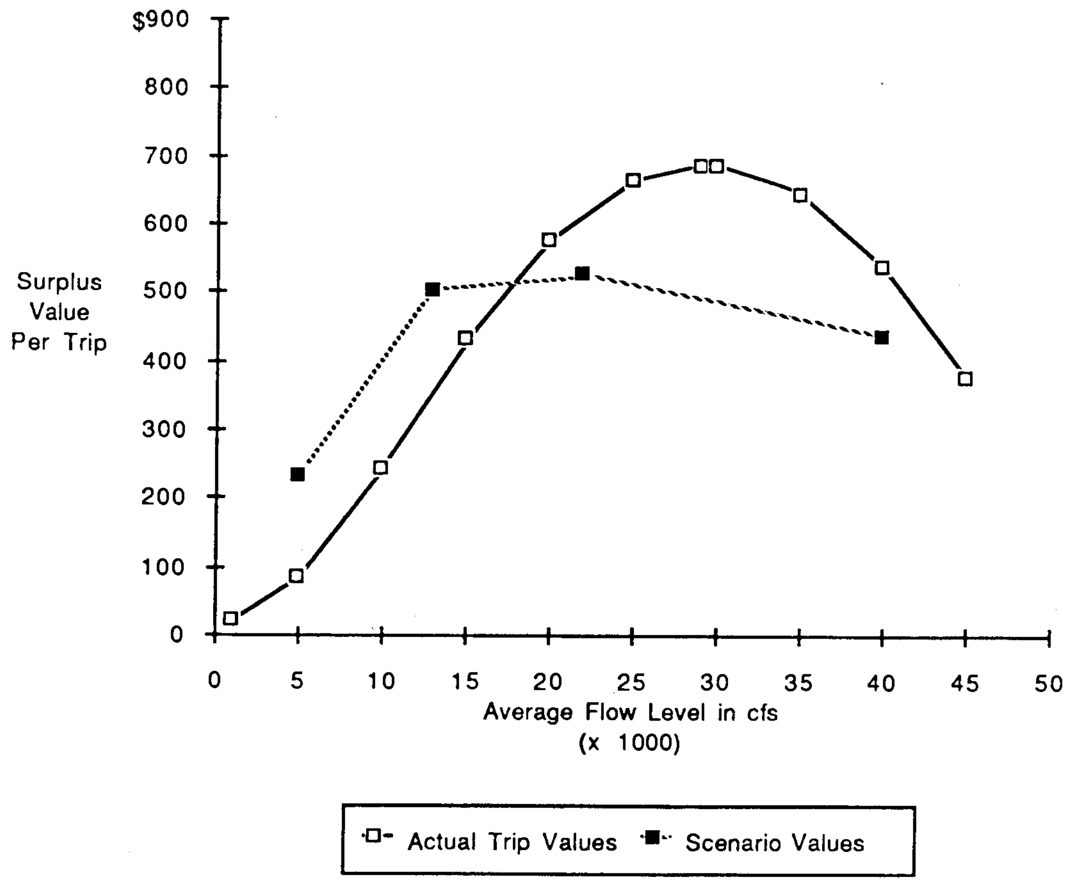
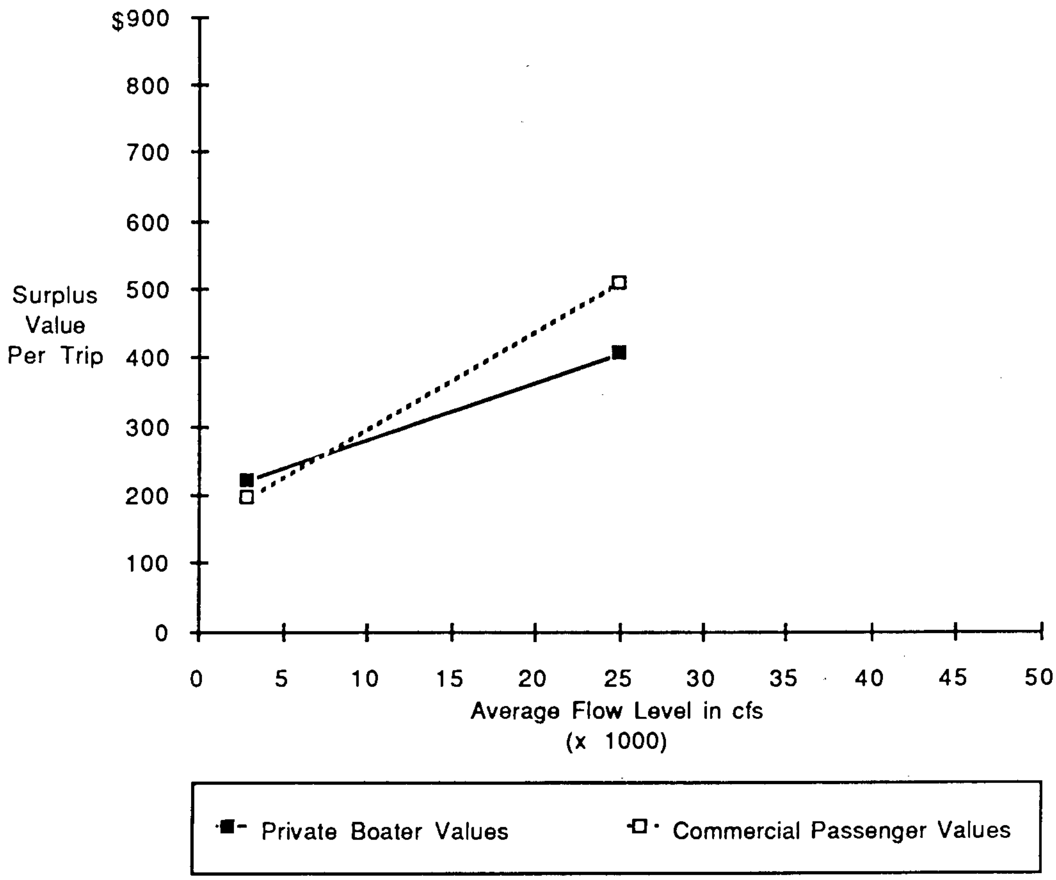


Figure 5-4

Commercial Passenger and Private Boater Surplus Values for Fluctuating Flow Scenarios ($ Per Trip)



CHAPTER 6

GLEN CANYON ANGLER SURVEYS AND RESULTS

Introduction

In this chapter we present the results of the attribute and contingent-valuation (CV) surveys of Glen Canyon anglers. The attribute survey was designed to provide a detailed understanding of the fishing experience and to identify the important attributes of the experience which are affected by flows. The results of the attribute survey, particularly with respect to the identification of flow-sensitive attributes, were used in designing the flow scenarios to be evaluated in the Angler CV Survey. The results of the Glen Canyon Angler CV Survey include an average actual trip surplus value, a flow value function based on anglers' surplus values for a variety of different flow scenarios, and values for two environmental impact scenarios.

Background

As noted in Chapter 1, the current Glen Canyon trout fishery is a by-product of Glen Canyon Dam. The dam provides more stable flows in this section of the Colorado River than had existed previously. The water is also colder and carries less silt. This new environment is ideal for trout, and the Arizona Game and Fish Department began a stocking program in 1964. As many as 100,000 rainbow trout have been stocked in some years, and in more recent years brook trout have been stocked as well. Fresh water shrimp were introduced to provide a forage base for trout in 1968 to provide forage for trout. They have flourished, providing ample support for the fishery.

Janisch (1985) has summarized the history of the fishery in four stages. The period 1964 to 1971 was the "put-and-take" era; catchable-sized trout were stocked and most were caught within a few months. The average weight of the rainbow trout taken was less than 0.75 pounds during this period, and fishing pressure was relatively light compared to more recent times.

Around 1971, shrimp started playing a major role in the trout's diet, and the growth rate apparently increased. This resulted in the trophy fishery era from 1972 through 1978. The average weight of fish harvested peaked at 3.53 pounds in 1978. Bag limits of 10 fish weighing a total of 40 pounds were not unusual during this period. Anglers responded to the trophy fishing opportunity, with the number of angler days growing rapidly. The presence of larger fish led

Arizona Game and Fish managers to suspect that substantial natural reproduction was occurring, and the stocking strategy shifted from introducing catchable-sized trout as practiced during the put-and-take era to stocking fingerlings as a supplement to natural reproduction. Research subsequently showed that the fishery is heavily dependent on stocking, and that only a limited amount of natural reproduction is taking place.

In 1978, the bag limit was reduced from ten to four trout in an attempt to protect the resource from ever increasing fishing pressure. In 1980, a rule was enacted requiring that trout either be released or killed immediately after being caught. This rule was an attempt to discourage people from keeping fish alive for extended periods and then releasing them if a larger fish was taken, a practice resulting in a high mortality rate for the released fish. Even though the fishery has declined in productivity since 1978, fishing pressure continued to escalate until 1984. Janisch has termed the period from 1978 to 1984 the "quality fishery" era. Creel census reports still showed a very respectable average weight of 2.79 pounds for fish caught and kept through this period. However, the days of the trophy fishery were ending and the average weight of fish taken declined steadily.

Janisch characterized the current era, beginning in 1985, as a period of "something less than quality but not put-and-take." Catch rates are still relatively high with some large fish taken, but most fish are small in comparison to the trophy era. Anglers have responded by greatly reducing participation from the peak of 52,000 angler days in 1983 to only 15,000 angler days in 1985. To further reduce fishing pressure, the Arizona Game and Fish Department enacted a lures only regulation which took effect on January 1, 1986. Preliminary indications are that this has further reduced participation in the fishery. Many anglers appear to have discontinued fishing in Glen Canyon rather than use artificial lures. The current management objective is to reduce fishing pressure and to continue stocking trout to restore the fishery to the "quality," if not the "trophy," level.

Attribute Survey Procedures

Sampling. No convenient list of names and addresses of Glen Canyon anglers is available, so the only way to identify users is to contact them on-site. Since the attribute survey was relatively short (see Appendix F), it was conducted on-site. Two trained interviewers administered the attribute survey to anglers.

The sampling strategy for the attribute survey was constrained by the overall study deadline. It would have been desirable to sample anglers randomly across a full year to be sure that there were no seasonal biases in the responses. However, to keep the project on schedule, sampling for the attribute survey was limited to November and December, 1984. These are relatively high use months, especially November, because fishing is often good. Unfortunately, Glen Canyon Dam flow releases were stable at about 25,000 cfs for the entire sampling period, so we could not sample anglers over a variety of flows. While not ideal, this sampling scheme was adequate to identify major attributes of the fishing experience.

The goal was to sample 200 anglers. Anglers were sampled on November 23, 24, 26, 29 and 30, and December 1, 2, 4, 6, 11, and 14. The sampling strategy involved contacting anglers between 3 PM and dark, when they were coming off the water after a day of fishing. Boat anglers were contacted as they arrived at the Lee's Ferry boat dock. Bank anglers were approached as they fished along the bank in the dock area or as they were leaving through the Lee's Ferry parking lot. One half of the adult members from each boat or party of bank anglers were asked to fill out a one-page questionnaire.

Response Rate. A total of 211 completed on-site questionnaires were obtained. This represents 92.5 percent of all the anglers contacted (7.5 percent of the sampled anglers declined to complete the attribute survey). Congestion at the boat dock and the high use level on Thanksgiving weekend may have resulted in our missing as many as five boats on November 23 and four boats on November 24. When these missed parties are counted, the response rate for the attribute survey was 87.8 percent. The reasons most often cited by those refusing to participate were that it was too dark and that there was insufficient time. A large share of the nonresponses occurred during the congested period on Thanksgiving weekend.

Attribute Survey Results

Glen Canyon Angling Experience. In order to better understand the effects of flow levels on fishing, it will be helpful to segment results based on the amount of experience respondents had with alternative water flows prior to the interview. Two measures of experience will prove useful. First, we asked study participants how many years they had fished in Glen Canyon. More than one-third (37 percent) reported that 1984 was their first year, while 12 percent had only fished at Lee's Ferry for two years. Twenty-seven percent of the respondents had fished there for three or four years, and only 21 percent reported having fished at Lee' Ferry for more than five years. The highest level of experience reported was 25 years.

Respondents were also asked about their experience with various flows. Results of this question are summarized in Table 6-1. During the sampling period, the river flow was constant at approximately 25,000 cfs, so all respondents had experienced relatively high steady flows. Forty-four percent reported having fished in Glen Canyon at medium flows (9,000 - 16,000 cfs), while 38 percent reported fishing experience at low flow levels (9,000 cfs or less). More than half, 54 percent, reported having fished in Glen Canyon during periods of daily fluctuations in flows. It is interesting to note, however, that about one of three sampled anglers indicated that they didn't know if they had fished under the various flow levels. For two of the three water levels (low and medium), more than 50 percent of the respondents either had not fished or didn't know if they had fished under those conditions.

Table 6-1. Respondent Reported Fishing Experience At Specified Flow Levels

Responses	Proportion Reporting Experience With Flow		
	Medium Flow (9,000-16,000 cfs)	Low Flow (Less than 9,000 cfs)	Fluctuating Flow
Yes, Experienced	44%	38%	54%
No, Did Not Experience	20	27	16
Don't Know	36	35	30

When classified by reported historical experience with water levels, 48 percent of the anglers had experienced only high flows, 5 percent reported experience with high flows and at least one other flow level (medium or low), and 48 percent reported experience with high flows and at least one other flow level, as well as fluctuating flow levels (see Table 6-2). This bimodal distribution of reported experience with flow levels is not surprising given that 49 percent of the sample reported having fished at Lee's Ferry for two or less years, a period during which high flows were the rule rather than the exception.

Since flows were relatively constant during the attribute survey, it was not possible to directly measure their impact on the perceived quality of respondents' most recent fishing trips. Inferences about these impacts were made from answers to questions about the expected impacts of flow levels. Responses to these questions were examined to determine if they are systematically linked to respondents' historical experience with various flow levels.

Table 6-2. Respondents Having Experience With Various Flow Levels

Flow	Proportion With Experience
High Flows Only (greater than 16,000 cfs)	48%
High and Low or Medium Flows	5
High, Low or Medium, and Fluctuating Flows	48

Both years of fishing experience at Lee's Ferry and the range of flows experienced were used to analyze the effects of experience on anglers' responses. While these two measures of experience may be important in the analysis of responses to questions about the impacts of water level, it is important to note two facts. Of the anglers having two or less years of experience at Lee's Ferry, 18 percent reported having fished at Lee's Ferry during medium flows (9,000-16,000 cfs), 8 percent reported fishing at Lee's Ferry during low flows (9,000 cfs or less), and 22 percent reported fishing at Lee's Ferry during fluctuating flows. Given that the two years prior to the attribute survey had seen fairly constant and high flows, some anglers may have answered the water level experience question incorrectly. Secondly, the years of experience classification may not provide a subsample of anglers that have experienced all flows. For example, an angler with more than two years of experience may still have fished only during certain water levels.

At several points, respondents' answers are broken down by experience level. Anglers with more than two years of experience, as well as reported exposure to daily fluctuations in flow level were classified as "experienced."

Important Attributes. To identify the attributes that contribute most, either positively or negatively, to the Glen Canyon fishing experience, respondents were first asked the importance of various reasons in their decision to fish at Lee's Ferry rather than somewhere else. Table 6-3 shows that the two most important reasons in the decision to fish in Glen Canyon are the size and the number of fish the respondent expected to catch. This result holds true for experienced and inexperienced anglers and for boat anglers as well.

The least important reasons for fishing at Lee's Ferry are the lack of other trout fishing areas and its location relative to home, indicating there are substitutes for the Glen Canyon fishery.

Table 6-3. 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
Thought I would catch a large fish	86%	82%	84%	88%
Thought I would catch a lot of fish	75	73	75	77
Wanted to fish in Glen Canyon	57	50	51	65
Few other trout fishing areas available	41	37	40	45
Close to home	33	39	42	28

* 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.

Respondents were also asked to rate the importance of various factors in contributing to a <u>perfect</u> or <u>excellent</u> fishing trip. As shown in Table 6-4, the two most important attributes of an excellent or perfect Glen Canyon fishing trip are "catching a trophy fish" and "good weather." "Camping along the river" is the least important attribute for all groups of respondents. The relative rankings of attributes are quite consistent for both categories of experience and for boat anglers.

Respondents were also asked to rate the importance of a list of factors that might contribute to a <u>poor</u> fishing trip. As shown in Table 6-5, the most important factor contributing to a poor trip was

"Catching no fish." Other important factors were, in order of importance, "Not being able to get upstream to fish," "Boat/motor trouble due to water level," "Poor weather," and "Seeing many others," all of which were rated as important by 64 percent or more of the respondents from each of the groups.

Table 6-4. Attributes Contributing to an Excellent or 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
Good weather	84%	80%	80%	84%
Catching a trophy fish	79	79	85	83
Catching your limit	68	59	64	68
Seeing few others	67	66	76	70
Low water	60	66	70	59
High water	54	54	59	54
Falling water level	52	55	59	47
Rising water level	51	56	54	49
Camping along the river	26	27	34	27

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

Table 6-5. Attributes Contributing to 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
Catching no fish	89%	85%	83%	88%
Not being able to get upstream	79	70	76	87
Poor weather	78	76	75	77
Boat/motor trouble due to low water	74	67	72	81
Seeing many others	71	64	71	74
Not catching your limit	63	58	60	64
High water	61	66	71	61
Low water	61	69	75	61
Falling water level	58	54	67	54
Rising water level	57	61	56	55
Not catching a trophy fish	57	53	56	59
Not being able to camp along the river	31	29	33	33

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

In addition to important attributes of a Glen Canyon fishing experience, anglers were also asked about their knowledge of the flow level on the day of their trip. Anglers were the recreation group most likely to have made several visits and, consequently, may have been most inclined to find out about the flows at the time of their trip.

The majority of anglers (75 percent), however, did not try to find out the expected flow prior to arriving at Lee's Ferry. Twenty-five percent attempted to learn the expected flow level, and about 70 percent of these anglers were successful. Experienced anglers were more likely to try to find out the expected flow level before the trip, but even among those who had experienced a variety of flows, only 38 percent reported seeking information prior to arriving at Lee's Ferry. This result does not necessarily imply that anglers are uninterested in flow levels or that their fishing experiences are unaffected by flows, but rather, that there may be other more constraining factors which determine the days on which they go fishing. For example, most people only have a limited amount of free time and it may be unrealistic to expect that an angler will only go fishing on his or her free days when preferred flows exist. It may be that most go fishing when they can and then adapt their fishing techniques to the flow levels they experience.

Since nearly all anglers sampled for the attribute survey experienced relatively high flow levels on their trip, we also asked respondents to assess the impact of a lower water level on several attributes of a Glen Canyon fishing trip. Among anglers with an opinion, there was a general consensus that water levels lower than 25,000 cfs would improve the chances of catching fish as well as the chances of catching a trophy fish (Table 6-6). Experienced anglers expressed a belief that lower water would be more likely to increase the probability of catching fish. However, these proportions were only slightly higher than those for catching a trophy fish. Experienced anglers also were more likely to think that low water would increase the chance to fish in certain preferred areas.

In summary, the results of the attribute survey indicate that two factors dominate the evaluation of fishing trips at Lee's Ferry--<u>catching fish</u> and <u>the weather</u>. Other secondary (but still important) factors include the degree of crowding, the ability to get upstream, and boat/motor trouble. Respondents, especially experienced respondents, felt lower water would improve the chances of catching a fish in general and increase the chances of catching trophy fish in particular. They also felt lower flows would improve their chances to fish certain preferred areas.

Table 6-6. Perceived Effects of Low Flow Levels on a Glen Canyon Fishing Experience

Attribute	Proportion of Respondents Stating Low Water Would Increase Activity*			
	All Anglers	More than Two Years Experience	Experience With Fluctuating Flows	Boat Anglers
Chances of catching a trophy fish	43%	49%	54%	40%
Chances of catching fish	43	54	56	40
Chance to fish certain preferred areas	36	45	50	32
Amount of time spent fishing	25	29	35	24
Problems with boat or motor	20	21	26	23

* These percentages are derived from respondents' answers to a question in which they were asked whether a low flow level would increase, decrease, have no effect, or don't know effect on specified activities. The percentages reported here record the proportions of respondents saying a low flow level would increase the activity.

Contingent-Valuation Survey Procedures

Sampling. The sampling frame for the Glen Canyon Angler Contingent-Valuation Survey consisted of anglers at Lee's Ferry on 75 selected days between April 29 and December 19, 1985. A sampling period of this length was chosen to minimize the potential for a seasonal bias in the types of anglers selected to participate in the study. The same procedures used for the angler on-site attribute surveys were used to contact anglers and to solicit their names and addresses for the CV mail survey.

Our field personnel estimated that 986 anglers were eligible for selection on the 75 specified sampling days, and they were able to contact 900 (91 percent). Some anglers were missed during busy times at the dock, while others had not returned by dark. For the 900 anglers contacted, 774 completed the on-site questionnaire (86 percent) and provided a usable name and address for the mail survey. The remaining 126 anglers either declined to complete the on-site questionnaire or listed insufficient or illegible address information. The sampling frame, then, contained 86 percent of the anglers contacted and 78 percent of the estimated total number of anglers.

Three hundred of the anglers who provided usable address information during the period April 29 through July 29, 1985 had been previously selected to participate in the Glen Canyon Anglers CV Pretest Survey (See Appendix K for the goals and results of the pretest). Of the remaining anglers in the sampling frame, 298 were randomly selected to participate in the final CV survey. The results of this latter survey are presented in this report.

Response Rate. The Glen Canyon Angler CV mail survey was conducted during January-March, 1986. Overall, 237 completed questionnaires were returned, 80 percent of the total sample. Two of these responses were subsequently excluded from the data analyses; one individual responded to a faulty questionnaire and the other was only 13 years old. Thus, the results presented in this report are based on 235 usable responses. Summary statistics for the response are presented in Table 6-7.

Table 6-7. Glen Canyon Angler CV Survey Response Rate

Surveys	Percent of All Surveys	Percent of Deliverable Surveys**
Completed Surveys	79%	82%
Undeliverable *	3	--
Not applicable	1	--
Surveys not returned	17***	18
Refusal	0	0
TOTAL	100%	100%

* Two surveys were returned, but were not included in the data analyses. As noted in the text, one of these was from an individual who was only 13 years of age and the other was returned by an individual who responded to a faulty survey.

** The percentages in this column are computed from a sample size of 288 rather than 298. The undeliverable and not applicable surveys have been excluded.

*** Indicates a number which is less than one percent of the sample, i.e., only one angler refused to participate in the survey.

Contingent-Valuation Survey Results

Actual Trip. The valuation section of the Angler CV Survey was initiated with a question about the actual expenditures incurred on their trip (see Figure 3-5 for the specific question format). On average, respondents reported expenditures that totaled about $189 for the trip (Table 6-8). This is the actual sum of average expenditures for individual items. However, when asked to add up their expenditures, respondents reported a slightly lower average total of $156 for the trip. This difference may be due to computational errors, or it may simply reflect respondents' best guess as to how much they really spent in total. Regardless of the reason for this difference, respondents were instructed to refer to perceived total expenditures (the mean of $156) when responding to the subsequent CV questions.

Table 6-8. Average Expenditures Reported by Anglers on the Trip When On-Site Interview Completed

Item	Amount Spent
Gas and Oil for Vehicle	$ 40
Food and Beverages	40
Lodging, Camping	24
Fish Equipment/bait/license	20
Guide Fees	13
Boat and Equipment Rentals	7
Air fare	9
Car Rental	1
Other	35
TOTAL	$189

After determining their total expenditures for the actual trip, respondents were presented with a dichotomous-choice CV question in which they were asked if they would have gone on this trip if their expenses had increased by a specified amount. The specified amount presented to each angler was a randomly selected amount (offer) from a range of values determined by the results from the pretest survey.

The first step in the analysis of responses to the valuation question was to estimate a logit equation.[1/] Several variables in addition to the offer amount were used as independent variables to explain

1/ Maximum likelihood procedures were used to estimate logit equations.

responses. For the actual trip valuation analysis, independent variables included expenses actually incurred, whether or not a guide was employed, the season of the year when the trip took place, length of trip in days, and the number of fish caught, among others.[2/]

The probability of any given respondent answering yes to the valuation question decreased as the magnitude of the dichotomous-choice dollar offer increased. In addition to the offer amount, actual trip expenses and respondents' reported concern about the use of the CV results to increase license fees were significant at the 0.10 level in explaining responses to the dichotomous-choice question for the actual trip.

The sign of the coefficient on expenses indicated that those with higher expenses would also have higher surplus values. Economists, however, would ordinarily expect the opposite: other things being equal, the higher the expenditures, the smaller the surplus values.

The license fee variable was significant and the sign for this variable indicated that those who were concerned about fishing fees had lower values. This was interpreted as an indicator of strategic bias. The variable was coded as "1" if the respondent was concerned about increases in fishing license fees when answering the CV questions and zero otherwise. In calculating values, this variable was set equal to zero in the logit equation to eliminate the effects of strategic bias from the final results.

Most notable among the nonsignificant variables was the flow level experienced on the actual trip. However, further investigation of this result produced a reasonable explanation. About half of our sample experienced constant flows while half experienced fluctuating flows, where the latter was defined as a fluctuation of more than 10,000 cfs in the course of a 24-hour day. The sample was split on this basis and separate logit equations estimated for each. Coefficients for the two equations were significantly different at the 0.05 level, indicating that surplus values per trip are significantly different for constant and fluctuating flows.[3/] Actual trip surplus values were estimated to be $130 for constant flows and $104 for fluctuating flows (Table 6-9).

2/ The statistical analyses of the respondents' answers to the actual trip and each of the scenario valuation questions are summarized in Appendix N, and only the salient results with respect to estimated surplus values will be reported.

3/ The Chi-square statistic for this test is 8.53 with 3 degrees of freedom, indicating that the null hypothesis of no difference can be rejected at the 0.05 level.

Table 6-9. Estimated Glen Canyon Angler Surplus Values ($ Per Trip)

Type of Surplus Value	Surplus Values
Actual Trip:	
Constant Flow	$ 130
Fluctuating Flows	104
Scenarios:	
3000 cfs, constant	$ 60
3000 cfs, with fluctuations	77
10,000 cfs, constant	126
10,000 cfs, with fluctuations	87
25,000 cfs, constant	94
25,000 cfs, with fluctuations	68
40,000 cfs, constant	52
Chances of catching a trophy fish doubled	139
Chances of catching no fish doubled	64

Interestingly, the constant flows tended to occur at relatively high levels, averaging 28,800 cfs, while the fluctuating flows occurred at an average daily flow of only 11,900 cfs with an average daily fluctuation of 15,500 cfs. Of those who had experienced a constant flow level, none experienced an average flow below 10,000 cfs, and 75 percent experienced an average daily flow between 20,000 and 30,000 cfs. In contrast, only two of the respondents who experienced a fluctuating flow level were on the river when the average flow exceeded 20,000 cfs. In fact, 75 percent of these respondents experienced an average daily flow between 5,000 and 15,000 cfs. This unequal distribution of flow levels experienced by anglers confounded our efforts to isolate the effects of differences in the average daily flow on actual trip surplus values.

Although the data did not permit quantification of the relationship in the actual trip equation, the importance of flows to fishing quality is borne out in the attribute survey data by the significant difference between the responses to the actual trip valuation question between those who experienced constant flows and those who experienced fluctuating flows, and the scenario values to be presented below. With adequate data, the relationship between flows and surplus values would, we believe, be statistically significant for actual trip data. However, given inadequate data relating flows to actual trips, the flow-value curve for anglers will be based on responses to the scenarios through which all anglers evaluated a variety of different flow conditions.

Two other variables which were not significant in the logit analysis are worth noting. One was an indicator of respondents' self reported confidence about their responses to the CV questions. This finding suggests that hypothetical bias was not a problem in this analysis. The other variable was constructed to assess the possibility of seasonal bias. This was a concern because our sample was not fully representative of anglers across the entire year of 1985. The sampling period extended over almost eight months, but sampling did not occur on every day during this period, and 300 of the anglers contacted early in the year were used for the pretest. The season variable was not significant, indicating that value estimates for actual trips are not affected by season.

Scenarios. Respondents were asked to evaluate a total of nine scenarios (see Table 6-9). As with the analysis for the actual trip valuation question, several variables were tested to determine if they had a statistically significant effect on surplus values. The amount of increase in expenses was significant at the 0.10 level or better in all nine cases. The variable measuring actual trip expenditures was significant at the 0.10 level in six of the nine cases and, once again, there was a positive relationship between expenditures and expected values, a result that was unanticipated. We found no evidence of strategic bias or hypothetical bias in respondents' answers to the scenario valuation questions. See Appendix N for details of the analyses for scenario valuation questions.

With so many scenarios, one concern was whether respondents' answers to the associated valuation questions might be affected by the order in which the scenarios were presented. As respondents worked through the questionnaire, they might have become bored with the process or later responses might have been influenced by how they responded to earlier scenarios. To test for the possibility of an "ordering effect," two different survey booklets were designed, differing only in the sequence in which the scenarios were presented. Sampled anglers were randomly assigned to one of the two survey groups. Statistical analysis of responses to these two sequences of scenarios failed to reveal an ordering effect, indicating that the order in which the scenarios were evaluated by respondents did not affect surplus values. See Appendix N for the full analysis.

The estimated surplus value per trip for each scenario is summarized in Table 6-9. Because these values will be used to derive the estimated flow value function and for other purposes, each scenario is discussed briefly below.

Case 1 - Constant Flow of 3,000 cfs. This first scenario represents a Glen Canyon fishing experience at a low flow level that is constant at 3,000 cfs. The fishing experience was described to respondents in the following manner.

> **Boat anglers have said that getting upstream to fish can sometimes be a problem at low water (3,000 cfs or less). At a constant flow of 3,000 cfs, large boats can't get past the sand and gravel bar three miles upstream from Lee's Ferry, while even very small boats may have to be dragged over slippery rock gravel bars. Consequently, nearly all of the fishing would occur in the three miles just above Lee's Ferry. In addition, damage to boats and motors is somewhat more frequent than at higher water levels. However, low water tends to concentrate fish, and bank anglers can find large areas of exposed gravel and rocks leaving a great deal of space between the water and the edge of the vegetation.**

The majority of respondents (64 percent) felt that this scenario represented an angling experience that would be "worse" than their actual trip, while 23 percent said that this would be a "better" experience (Table 6-10). The surplus value respondents assigned to this scenario is $60 per trip.

Table 6-10. Rating of the 3,000 cfs Constant Flow Scenario Relative to Actual Trip

Rating	Proportion Citing Rating
Better	23%
Worse	64
About the same	13

Case 2 - Average Flow of 3,000 cfs with Fluctuations. For this scenario respondents were asked to evaluate an angling experience with daily fluctuations in flow levels from 1,000 cfs to 15,000 cfs, with an average flow of 3,000 cfs. This scenario was described to respondents as follows.

> **The questions above asked about a relatively constant flow of 3,000 cfs. Daily changes in the water flow may have other effects, in addition to those described in Case 1, on the quality of fishing. With flows changing daily from a low of 1,000 cfs to a high flow of 15,000 cfs (around an average flow of 3,000 cfs), boats may get swamped if they are tied too tightly to the bank during a fluctuation. There is also a chance of getting stranded above 3 mile bar if the water drops substantially. On the other hand, biological studies**

> **give some indication that rising water may cause the fishing to improve as fish begin to feed on the debris stirred up by the rising water.**

After reading this description, respondents were asked whether daily fluctuations around an average flow of 3,000 cfs would "hurt," "improve," or "make no difference" in a Glen Canyon fishing experience relative to a constant flow of 3,000 cfs (Case 1). The largest group of respondents (44 percent) said that fluctuations would hurt the fishing experience, while 36 percent said that fluctuations would improve the fishing experience (Table 6-11).

Table 6-11. Rating of the 3,000 cfs with Fluctuations Scenario Relative to the 3,000 cfs Constant Flow Scenario

Rating	Proportion Citing Rating
Improve the fishing experience	36%
Hurt the fishing experience	44
Make no difference	20

The surplus value assigned to this scenario by respondents is $77 per trip. This value is not statistically different from the $60 surplus value respondents assigned to the 3,000 cfs constant flow scenario.[4/] Thus, based on surplus values, we would conclude that large daily fluctuations around a low average flow of 3,000 cfs would neither hurt nor improve a Glen Canyon fishing experience, on average, relative to a constant flow of 3,000 cfs.

Case 3 - Constant Flow of 10,000 cfs. This scenario describes an angling experience at a moderate flow that is constant at 10,000 cfs. The scenario description provided to respondents is as follows:

4/ The Chi-square statistic for this test is 3.18 with 2 degrees of freedom, indicating that the null hypothesis of no difference cannot be rejected at the 0.10 level.

Boat anglers seem to experience fewer problems with damage to their boats and motors when the water is at least 10,000 cfs, and boats can get up and downstream with no difficulty. At a flow of 10,000 cfs, bank anglers would still find exposed gravel and rock bars and some room between the water's edge and shore vegetation. In previous studies, about 40 percent of the anglers have said that they feel the fishing is generally better at constant flows of 10,000 cfs than when the water level is higher.

A majority of respondents (56 percent) felt that this scenario represented a "better" fishing experience than their actual trip, while only 13 percent felt that the experience would be "worse" (Table 6-12). The 56 percent who indicated that this experience would be better than their actual trip is significantly larger than the 23 percent who said that Case 1 (3,000 cfs) would be better than their actual trip, indicating that respondents prefer the 10,000 cfs flow level to the 3,000 cfs flow level described in Case 1.

Table 6-12. Rating of the 10,000 cfs Constant Flow Scenario Relative To Actual Trip

Rating	Proportion Citing Rating
Better	56%
Worse	13
About the Same	31

The surplus value assigned to this scenario by respondents is $126 per trip. This surplus value is significantly different from the $60 surplus value reported for the 3,000 cfs constant flow scenario.[5/] Thus, an increase in the flow level from 3,000 to 10,000 cfs significantly increases angler surplus values.

5/ The Chi-square statistic for this test is 38.02 with 2 degrees of freedom, indicating that the null hypothesis of no difference can be rejected at the 0.01 level.

Case 4 - Average Flow of 10,000 cfs with Fluctuations. This scenario represents an angling experience with daily flows ranging from 1,000 cfs to 22,000 cfs, with an average daily flow of 10,000 cfs. The scenario description is presented below.

> **The questions above asked about a relatively constant flow of 10,000 cfs. Daily changes in the flow may have other effects on the quality of fishing in addition to those described above for Case 3. At moderate flows, large daily fluctuations from a low flow of 1,000 cfs to a high flow of 22,000 cfs (around an average of 10,000 cfs) may contribute to the swamping of boats tied to the bank or dragging anchors. There would still be a chance of getting stranded above 3 mile bar. Again, however, there is some indication that the rising water may improve fishing as fish begin to feed on debris stirred up by the rising water.**

After reading this scenario, respondents were asked whether the described conditions would "hurt," "improve," or "make no difference" in a Glen Canyon fishing experience relative to a constant flow of 10,000 cfs. A majority of respondents (53 percent) said that fluctuations would hurt the fishing experience, while 30 percent said that fluctuations would improve the fishing experience (Table 6-13). The 53 percent indicating that fluctuations would hurt the fishing experience at 10,000 cfs is significantly larger ($p<0.05$) than the 44 percent of respondents who said fluctuations would hurt the fishing experience at 3,000 cfs. This result suggests that anglers feel fluctuations have a more adverse effect on a fishing experience at 10,000 cfs than at 3,000 cfs. The surplus values reported below support this conclusion.

Table 6-13. Rating of the 10,000 cfs with Fluctuations Scenario Relative to the 10,000 cfs Constant Flow Scenario

Rating	Proportion Citing Rating
Improve the fishing experience	30%
Hurt the fishing experience	53
Make no difference	17

The surplus estimate for this scenario is $87 per trip. This value is statistically different from the surplus reported for the 10,000 cfs constant flow scenario of $126.[6/] In contrast to the finding that fluctuations neither hurt nor improve a fishing experience at an average flow of 3,000 cfs, we found here that daily fluctuations in a moderate flow level (10,000 cfs) significantly reduces angler values.

Case 5 - Constant Flow of 25,000 cfs. For this scenario respondents evaluated a moderately high constant flow level of 25,000 cfs. The scenario description provided for respondents is presented below.

> **Next, consider a constant flow of 25,000 cfs. There is no minimum motor horsepower restriction, although motors with 10 h.p. or less may have problems getting upstream. The chance of damage to boats and motors due to obstructions in the water are small, but the high flows of 25,000 cfs may increase the chances of swamping a boat while dragging an anchor, especially for inexperienced boaters.**
>
> **Fish may be less concentrated at this higher flow level. Bank anglers may have less space between the waters edge and bank vegetation, but eddies along the shoreline are often larger and more pronounced. About 12 percent of the anglers in a recent survey felt that fishing was better at 25,000 cfs than at lower water levels in Glen Canyon.**

The largest group of respondents (44 percent) felt that the conditions presented in this scenario were "about the same" as they had experienced for their actual trip (Table 6-14). This result is not surprising given that the average flow experienced by all respondents was 20,500 cfs.

Table 6-14. Rating of the 25,000 cfs Constant Flow Scenario Relative to Actual Trip

Rating	Proportion Citing Rating
Better	23%
Worse	33
About the same	44

6/ The Chi-square statistic for this test is 10.60 with 2 degrees of freedom, indicating that the null hypothesis of no difference can be rejected at the 0.01 level.

Respondents assigned a surplus to this scenario of $94 per trip. This surplus value is significantly different from the value of $126 reported for the 10,000 cfs constant flow scenario.[7/] Thus, for a large increase in the average daily flow level from 10,000 to 25,000 cfs, angler surplus values decline.

Case 6 - Average Flow of 25,000 cfs with Fluctuations. This scenario presents an angling experience with fluctuations in flow levels from 12,000 cfs to 32,000 cfs, with an average daily flow of 25,000 cfs. The scenario respondents were asked to evaluate is as follows.

> **The impacts of large daily fluctuations are somewhat different at higher water than at lower water levels. With fluctuations from low flows of 12,000 cfs to high flows of 32,000 cfs (around an average flow of 25,000 cfs), it is very unlikely boats would get stranded above 3 mile bar. Boats tied too tightly to the shoreline, however, may be flooded. Rising water might also trigger more feeding by fish, but fish become more difficult to find because of the higher water and faster current. In the long run, large daily fluctuations at this flow level may wash away many of the campsites upstream from Lee's Ferry.**

The majority of respondents (65 percent) felt that fluctuations at an average flow of 25,000 cfs would hurt the fishing experience (Table 6-15). This proportion is significantly different, at the 0.01 level, from the 53 percent who said fluctuations would hurt fishing at 10,000 cfs and the 44 percent who said fluctuations would hurt fishing at 3,000 cfs. These results indicate that fluctuations are perceived as being more problematic by Lee's Ferry anglers at higher flow levels.

Table 6-15. Rating of the 25,000 cfs with Fluctuations Scenario Relative to the 25,000 cfs Constant Flow Scenario

Rating	Proportion Citing Rating
Improve the fishing experience	16%
Hurt the fishing experience	65
Make no difference	19

7/ The Chi-square statistic is 6.91 with 2 degrees of freedom, indicating that the null hypothesis of no difference can be rejected at the 0.05 level.

The surplus value respondents assigned to this scenario is $68 per trip. This value is statistically different from the value reported for the 25,000 cfs constant flow scenario ($94), indicating that fluctuating flows also have a significant negative impact on angler values at moderately high flows.[8/]

Case 7 - Constant Flow of 40,000 cfs. This scenario describes a high flow level that is constant at 40,000 cfs. The scenario was described in the following manner.

> **At constant flows of 40,000 cfs, the current is swift and the Park Service requires all boat motors to have at least a 25 horsepower motor. Large boats can get up and down the river more easily than smaller boats. The chances of damage to boats and motors due to obstructions in the water are smaller than at lower flows. However, for inexperienced boaters the high water increases the chances of boats being swamped while dragging anchors. Eddies along the shoreline are larger and well defined, but bank anglers find the water is up into the bank vegetation and this may make bank fishing more difficult for them. At these high flows, fish feeding patterns may change since fish would generally stay out of the main current. Fish may be harder to find.**

The majority of respondents (79 percent) said that this scenario described an angling experience that would be worse than their actual trip, and only 5 percent rated the conditions as being better than their actual trip (Table 6-16).

Table 6-16. Rating of the 40,000 cfs Constant Flow Scenario Relative to Actual Trip

Rating	Proportion Citing Rating
Better	5%
Worse	79
About the same	16

8/ The Chi-square statistic for this test is 8.16 with 2 degrees of freedom, indicating the null hypothesis of no difference can be rejected at the 0.05 level.

The surplus value for this scenario is $52 per trip. This value is significantly different from the value of $94 for the 25,000 cfs constant flow trip.[9/] This result indicates that surplus values continue to decline at a very high constant flow of 40,000 cfs.

Change 1 - Bigger Fish. This scenario was not anchored to a particular flow level, but to the flow level experienced on the actual trip. This scenario was explained to respondents as follows:

> **A survey of anglers at Lee's Ferry last year showed that about 15 percent of them reported catching a fish larger than three pounds, and only 3 percent reported catching a fish larger than four pounds. These numbers reflect how an average angler might do on any particular day at Lee's Ferry. We realize that no one is exactly average, but we would like you to suppose that the fishery at Lee's Ferry changed in such a way that <u>your</u> chances of catching one of these bigger fish were to double. If you feel you are an average fisher, your chances of catching a fish bigger than three lbs. would now be about 30 percent, while your chances of catching a fish bigger than four lbs. would now be about 6 percent. If you think you are <u>not</u> an average fisherman at Lee's Ferry, your chances would vary accordingly.**

The estimated surplus values for this scenario is $139 per trip, indicating that increases in the probability of catching a larger fish is an important attribute of a Lee's Ferry fishing experience.

Change 2 - Chances of Getting Skunked. Here respondents were asked to evaluate a Lee's Ferry fishing experience where the chances of catching <u>no</u> fish were doubled, regardless of the flow level. The scenario description is presented below.

> **We are sure that almost every angler has experienced, at one time or another, "getting skunked" (catching no fish at all). In fact, about 20 percent of our respondents to a previous survey at Lee's Ferry reported they had not yet caught a fish. This number reflects how an average angler might do on any particular day at Lee's Ferry. No one is exactly average, but we would like you to suppose that the fishery at Lee's Ferry changed in such a way that <u>your</u> chances of getting skunked were to double. In other words, if you feel you are**

9/ The Chi-square statistic for this test is 28.99 with 2 degrees of freedom, indicating that the null hypothesis of no difference can be rejected at the 0.01 level.

an average angler and came repeatedly to Lee's Ferry, you could expect that on four out of ten trips you would catch no fish at all. If you were an above average angler, your chances of getting skunked would be <u>less</u>, and if you were below average, the chances would be greater than 4 out of 10 times.

The estimated surplus values for this scenario is $64 per trip. This indicates that doubling the chances of being skunked would significantly diminish Glen Canyon anglers' surplus values. The surplus value for this type of angling experience is comparable to the surplus value of $60 per trip for the 3,000 cfs constant flow scenario.

<u>Summary</u>

The results of the attribute survey revealed that <u>catching fish</u> and <u>good weather</u> are the dominant attributes of a Glen Canyon fishing experience. Other important attributes that could be affected by flow levels included the <u>degree of crowding</u> on the river, the <u>ability to get upstream</u>, and <u>boat or motor trouble</u> due to low water. These last two attributes are especially important to boat anglers.

The flow-sensitive attributes identified by the attribute survey were used in the design of flow scenarios to be evaluated by anglers. In addition, given anglers' concerns regarding catching fish, and catching a trophy fish in particular, two environmental impact scenarios were designed to assess the effects of long-run environmental changes on these attributes.

Respondents placed the highest surplus value ($139) on the scenario describing a fishing experience in which the chances of catching a fish greater than three pounds would be doubled. This result is not surprising given that Glen Canyon has become known as a trophy fishery and, on average, respondents had several years of experience with this fishery. At the other end of the continuum, respondents assigned the lowest surplus value ($52) to the 40,000 cfs constant flow scenario. This result indicates that very high flow levels in Glen Canyon significantly reduce angler surplus values.

Examining only the flow specific scenarios, respondents assigned the highest surplus value to the 10,000 cfs constant flow scenario ($126). The value for constant flow scenarios rose from $60 at 3,000 cfs to $126 at 10,000 cfs, and then declined to $94 at 25,000 cfs and $52 at 40,000 cfs. We found that all of the pairwise comparisons of surplus values from 3,000 to 10,000 cfs, 10,000 to 25,000 cfs, and 25,000 to 40,000 cfs were significantly different at the 0.05 level.

While these scenarios cannot be used to identify a specific optimum flow, the optimum would almost certainly fall in the 8,000 to 15,000 cfs range.

At a low flow of 3,000 cfs, there was not a statistically significant difference in surplus values for the constant flow and fluctuating flow scenarios. Given this finding, we will use a combined value of $68 for each of these scenarios in future analysis of flow release patterns from Glen Canyon Dam (see Figure 6-1). At higher flow levels, 10,000 cfs and 25,000 cfs, respondents placed significantly lower values on the fluctuating flow scenarios than they did on the corresponding constant flow scenarios. These findings indicate that fluctuations at low flows neither improve or hurt the experience for the average angler, but have a significant negative impact on surplus values at higher flows.[10/] Thus, Figure 6-1 maps out the flow value curves for constant and fluctuating flow levels. These surplus value-flow relationships are based on the analyses of response to the flow-specific scenarios. The constant flow function was derived by linear interpolation between the 3,000 and 10,000 cfs, 10,000 and 25,000 cfs, and 25,000 and 40,000 cfs constant flow scenario values. The 25,000 to 40,000 cfs line segment was extended to 45,000 cfs to cover the full range of flows to be evaluated and to maintain consistency with the white-water boater flow value functions. The fluctuating flow function was also derived by linear interpolation using the fluctuating flow scenario values.

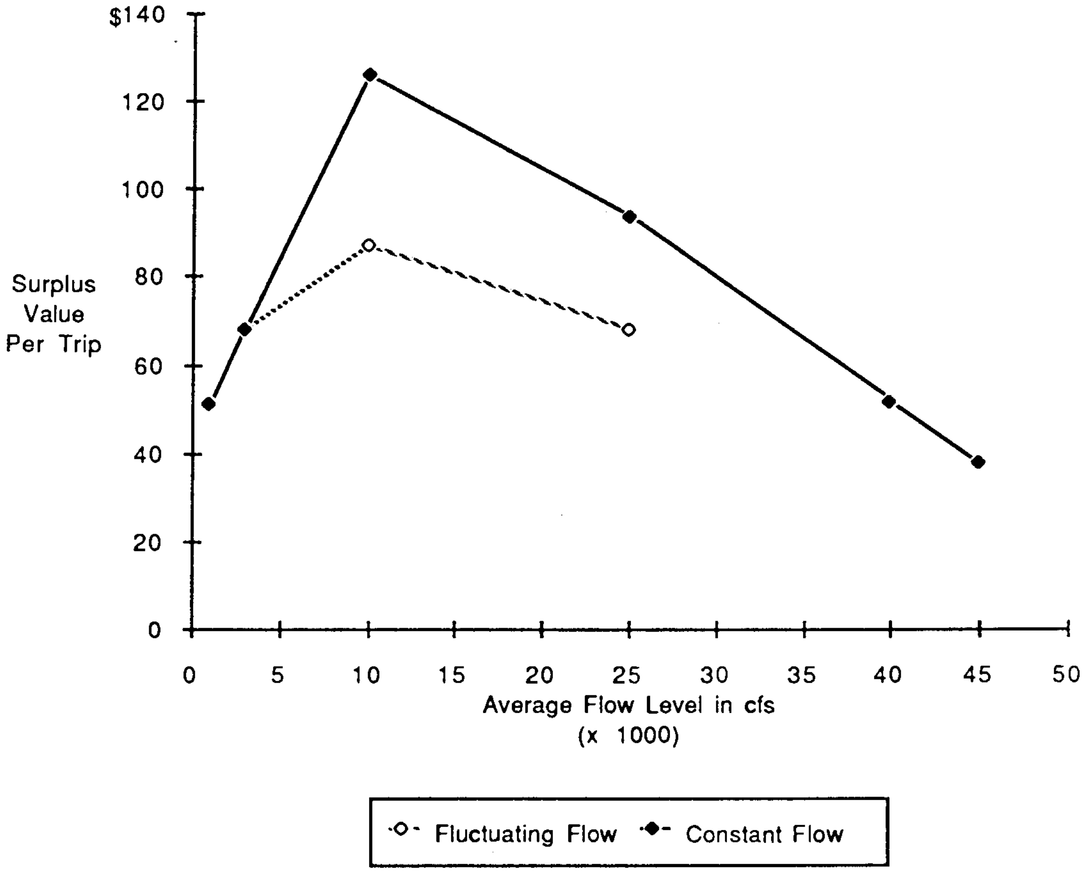
Final Observations

Two caveats need to be expressed regarding the use of the angler flow value functions. First, the change in regulations requiring that only artificial lures be used in Glen Canyon upstream from Lee's Ferry is a basic change in the parameters of the fishery. The effect on values is unclear. Among some segments of the angling public who prefer lures, this may enhance surplus values. We would speculate that for most anglers, however, the effect would be in the opposite direction. There are numerous unofficial reports of substantial reductions in participation and some displacement to sites downstream where access is more difficult but natural bait is legal.

10/ A scenario presenting a fluctuating flow around an average flow of 40,000 cfs was not evaluated because any flow level above 33,500 from Glen Canyon Dam can only occur as a constant flow, since the bypass tubes are open. In addition, the highest average flow that is possible under conditions of fluctuating flow is 25,000 cfs.

Figure 6-1

Glen Canyon Angler Flow Value Functions for Constant and Fluctuating Flow Levels ($ Per Trip)



The results reported here, and the history of the fishery, however, caution against assuming this is a permanent state of affairs. If the regulation, as intended, helps restore the trophy fishery of a few years ago, angler surplus values could be greatly enhanced.

A second caveat relates to the emphasis throughout this chapter on value per trip. Less attention has been given to number of trips taken per year by individual anglers. This concern stems from the history of the fishery. The number of angling days has dramatically changed in response to changing conditions over the years. Ideally, we would have estimated the effects of flows not only on surplus value per trip but also on the number of trips taken by anglers under the new conditions. However, this would have required many more resources than were available for this study. For example, if fishing conditions improved, not only would it be necessary to estimate the effect on the number of trips by current participants, but also the number of trips taken by new participants who were not in the user population in 1985. To gain information about these people may have required a general population survey of Arizona, Utah and California. Even with funds for such a survey, we are not convinced that the results would be reliable. Once fishing quality improved and use rates responded, additional issues such as the effect on fish populations and potential crowding might affect participation.

Given the unpredictable future of the fishery and, consequently, participation, we will value alternative operating plans for Glen Canyon Dam using 1985 values estimates and 1985 estimates of trips taken. This is a conservative approach since 1985 was a rather poor year for fishing and a year of steady high flows. Many of the flow regimes that will be evaluated in Chapter 8 have flows more favorable to fishing than those experienced by most of the 1985 anglers. Thus, the use of 1985 trips is probably an underestimate of the total number of trips that would be taken under more favorable conditions.

The ultimate effect of the lures regulation remains to be seen. To the extent that fishing improves, surplus values will be enhanced. If the management program fails, a return to 1985 conditions should be feasible by lifting the ban on natural bait. Thus, given the uncertainty surrounding the future of the fishery and participation relationships, use of 1985 values and participation rates is a reasonable way to represent the economic effects of alternative flow management regimes on the fishery. However, our computer model for evaluating flow regimes does have the option for the operator to input new (or revised) use rates if such information becomes available in the future and is determined to be more reliable than 1985 figures.

CHAPTER 7

DAY-USE RAFTER SURVEYS AND RESULTS

Introduction

The organization of this chapter follows the same format as was used in previous chapters for white-water boaters and anglers. Background information about rafting in Glen Canyon is present first, and a discussion of the results of the attribute survey of Glen Canyon rafters follows. The subsequent discussion of the contingent-valuation survey builds on these findings and includes an explanation of the relationship between respondents' surplus values and flow levels. The chapter closes with a summary of the major findings, highlighting the implications of these findings for future analyses of flow release patterns from Glen Canyon Dam.

Background

A Glen Canyon raft trip is a one-day flat water trip on a 15-mile section of the Colorado River through Glen Canyon. At low to moderate flow levels, generally less than 29,500 cfs, raft trips depart from a dock near the Glen Canyon Dam and float or motor downstream to Lee's Ferry. The motor is used primarily to maneuver the boat and to stay on schedule at relatively low flow levels. At flow levels above 29,500 cfs, which typically occur when the jet tubes at Glen Canyon Dam are open, trips depart from Lee's Ferry and motor upstream before floating back downstream. An alternate trip route is used at these high flow levels because it is not safe to depart from the base of the dam due to the volume and turbulence of the water released from the jet tubes. Most trips departing from Lee's Ferry do <u>not</u> go all of the way up the river, and passengers do <u>not</u> get a view of Glen Canyon Dam from the river.

All Glen Canyon raft trips have a professional guide to run the raft and explain the attractions along the river to passengers. Rafts departing from the dam have a capacity of 20 passengers, while rafts leaving from Lee's Ferry can only carry 10 passengers. This difference in raft capacity occurs because the outer pontoons are removed from the rafts on trips departing from Lee's Ferry to reduce the resistance from the water while motoring upstream.

Wilderness River Adventures is the only concessionaire authorized by the National Park Service to provide Glen Canyon raft trips. The Fred Harvey Transportation Company also participates in the provision of these trips by busing raft passengers from the South Rim to Glen Canyon for a raft trip.

Commercial Glen Canyon raft trips were provided from the late 1960's through 1982 by the Fort Lee Company. In Wilderness River Adventures' first year of operation (1983), they carried about 500 passengers through Glen Canyon. Since that time the number of passengers has increased to 8,469 in 1985, and as of August 31, 1986, they had carried 9,497 passengers for the current calendar year.

Wilderness River Adventures' sales brochure describes a Glen Canyon raft trip in the following manner.

> "Along the 15-mile route, you'll float leisurely past the multi-colored sandstone cliffs of Glen Canyon. Then take time out to explore ancient Indian petroglyphs on the canyon's sandy beaches. And enjoy a tasty picnic lunch along the shores of the Southwest's most celebrated river. End your float adventure at historic Lee's Ferry.
>
> Wilderness River Adventures includes everything you need for a safe and pleasurable raft trip. Our tour buses take you from Page to the launch site and pick you up again that afternoon. Our skilled, well-versed crew guides you in spaciously comfortable and sturdy neoprene rafts."

One might classify a Glen Canyon raft trip, therefore, as a leisurely one-day float trip on the Colorado River.

Attribute Survey Procedures

Sampling. The final attribute survey (see Appendix I) was sent to a sample of 300 individuals who took a Glen Canyon raft trip during the months of April through October, 1985. Names and addresses for the sample were obtained from Wilderness River Adventures and the Fred Harvey Transportation Company. The lists of names provided by these two companies, however, do not represent all of the 1985 Glen Canyon raft trip passengers.

Wilderness River Adventures only keeps a record of the name and address of the one individual per group that registers for a trip. This listing, then, represents only group leaders or heads of households, depending on the composition of the group taking the trip. Consequently, not all individuals from each group were eligible for selection in the sample.

The Fred Harvey Transportation Company provided a list of names and addresses for individuals who made advance reservations for their raft trip or who filled out a comment card after their trip. The advance registration list, like the list of names obtained from

Wilderness River Adventures, only represented group leaders and heads of households. The comment cards were simply a form for customers to fill out on which they indicated their satisfaction with the Fred Harvey Transportation Company bus ride to and from Glen Canyon and the Wilderness River Adventures raft trip through Glen Canyon. The list of individuals who filled out the comment cards was not restricted to heads of households and group leaders, however, they were a self-selected group and not necessarily representative of all passengers.

Despite its shortcomings, the sampling procedure provided a list of Glen Canyon raft trip passengers covering an entire rafting season. Sampled passengers would have the necessary experience to evaluate such a trip. Though not ideal, we felt this sample was adequate to identify the important attributes of a Glen Canyon rafting experience.

The sample was stratified into two groups according to the place of departure for the raft trip (the base of Glen Canyon Dam or Lee's Ferry). The purpose of this stratification was to identify whether large differences in flow level, as determined by place of departure, affected respondents' satisfaction with their Glen Canyon raft trips. All respondents, regardless of the origin of their raft trip, received the same survey.

A summary of the flow levels experienced by attribute survey respondents is presented in Table 7-1. Overall, 1985 was a year of medium to high flows, and as a result, none of the respondents experienced an average daily flow of less than 10,000 cfs. Glen Canyon raft trips left from the dam during all months of the sampling period (April through October) except June. Lee's Ferry launches occurred only in May and June, 1985.

Table 7-1. Daily Flow Levels Experienced By Respondents to the Glen Canyon Rafter Attribute Survey

Flow	Trip Origin	
	Dam	Lee's Ferry
Average flow	25,500 cfs	39,100 cfs
Average high flow	27,700	40,700
Average low flow	22,400	36,900

Response Rate. In November, 1985, respondents in the sample received their first survey contact. Overall, 220 completed questionnaires were returned, 73 percent of the total sample. Thirty questionnaires were returned incomplete because the recipient had registered in advance but did not take a Glen Canyon raft trip, and an additional 11 questionnaires were returned as undeliverable. The response rate as a percent of all deliverable questionnaires and individuals who had actually taken a Glen Canyon raft trip was 85 percent (see Table 7-2). The response rate did not differ by the origin of respondents' raft trips. The data presented in this section are based on the responses of 215 Glen Canyon raft trip passengers: 108 passengers from trips leaving from the Dam, and 107 passengers from trips departing from Lee's Ferry.[1/]

Table 7-2. Glen Canyon Rafters' Attribute Survey Response Rate

Surveys	Percent of All Surveys	Percent of Deliverable Surveys**
Completed surveys	73%	85%
Not applicable*	10	--
Undeliverable	4	--
Surveys not returned	10	11
Refusals	3	4
TOTALS	100%	100%

* These are the 30 respondents who made advance reservations, but did not take the trip.

** As noted in the text, 11 questionnaires were returned as undeliverable, and an additional 30 questionnaires were returned because the individual had not taken the trip. Thus, the percentages in this column are computed from a sample size of 259 rather than 300.

1/ Five surveys were received after the analysis of responses for this survey was completed. While these five are included in the response rates for Table 7-2, they are not included in the results reported here.

Attribute Survey Results

The ten most frequently cited attributes that would contribute to an excellent or perfect one-day raft experience are listed in Table 7-3. A good guide, rapids and faster water, good weather, and good food were the attributes listed most often. It should be emphasized that this question asked which factors would contribute to an excellent or perfect trip, and it did not measure whether respondents actually experienced the attribute on their trip.

Table 7-3. Attributes That Contribute Most To An Excellent or Perfect One-Day Raft Trip

Attribute	Proportion Citing Attribute*	
	Dam	Lee's Ferry
Good guide	28%	37%
Rapids and faster water	23	25
Good weather	15[a]**	26[b]
Good food	10[a]	20[b]
More stops and activities	10	6
Fewer people	8	6
Nice co-travelers	7	8
Shorter bus ride	5	6
Full run to dam	2[a]	9[b]
Shade at picnic area	1[a]	7[b]

* Some respondents listed as many as four attributes that would contribute to an excellent or perfect trip for them. Thus, the percentages listed reflect the relative number of respondents citing a particular attribute and, as a result, the columns do not add up to 100 percent.

** Statistics sharing a common superscript are not statistically different at the 0.05 level. Statistics with different superscripts are statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

Only two of the attributes listed in Table 7-3 appear, at face value, to be sensitive to flow levels: rapids and faster water and a full run up to the dam. However, further consideration suggests that rapids and faster water are not affected by flow levels. Most of the respondents experienced relatively high flow levels, 21,000 to 45,000 cfs on average, and it is unlikely that there would be an opportunity for faster water in most years. In addition, there are no rapids in Glen Canyon. In short, there is not much that can be done to provide a white-water rafting experience in Glen Canyon.

The desire by some passengers who took a trip starting at Lee's Ferry for a full run upriver to the dam is a flow-sensitive attribute. Glen Canyon raft trips are required to depart from Lee's Ferry at relatively high flow levels, and most of these trips do not motor far enough upstream for passengers to view the dam from the river.

The ten most frequently cited attributes that would contribute to a poor raft trip are listed in Table 7-4. Five of these attributes may be related to flow levels: too many people, boredom, no white-water, no stops, and too much motoring. Contacts with too many people may be related to flows in that rafts leaving from the dam have a capacity of 20 passengers while the rafts departing from Lee's Ferry have a capacity of only 10 passengers, requiring twice as many boats to carry the same number of passengers. Because we did not find a significant difference in the proportion of respondents citing this attribute between the two types of trips, we concluded that "too many people" was not related to flow levels.

Boredom appeared to be an attribute that would be more of a concern to passengers from Lee's Ferry trips since they saw the same scenery twice. An analysis of the percentage of respondents citing this attribute, however, revealed that those leaving from the dam, rather than those leaving from Lee's Ferry, were more likely to cite boredom as a negative attribute. As a result, we concluded that this attribute is also not related to flow levels.

For reasons already stated, the absence of white-water or rapids should not be considered as a flow-sensitive attribute. Finally, no stops and too much motoring were not considered to be flow-sensitive attributes. Our understanding, from discussions with representatives of Wilderness River Adventures, is that all raft trips make the same number of stops and do approximately the same amount of motoring, regardless of the origin of the trip.

Table 7-4. Attributes That Contribute Most To A Poor One-Day Raft Trip

Attribute	Proportion Citing Attribute*	
	Dam	Lee's Ferry
Poor weather	38%**	38%
Poor guide	22^{a}	32^{b}
Poor food or no food	14	11
Disagreeable people	9	9
Boredom	9^{a}	2^{b}
No white-water	9	4
Too many people	8	12
No stops	6^{a}	1^{b}
Too much motoring	5	1
Poor boat condition	3	6

* Some respondents listed as many as four attributes that would contribute to a poor trip for them. Thus, the percentages listed reflect the relative number of respondents citing a particular attribute and, as a result, the columns do not add up to 100 percent.

** Statistics sharing a common superscript <u>are not</u> statistically different at the 0.05 level. Statistics with different superscripts <u>are</u> statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

The attribute survey dealt with respondents' knowledge of the flow level on the day of their raft trip. Nearly everyone who responded (94 percent) did not know the expected water level on the day of their trip (see Table 7-5). Of those who did know the expected water level, none said that it influenced their decision to take the trip. These results are exactly the same across trip origins.

Table 7-5. Respondents' Knowledge of the Expected Water Level

Response	Proportion Who Knew Water Level	
	Dam	Lee's Ferry
Did not know expected water level	94%	94%
Knew expected water level		
- influenced decision to take raft trip	0	0
- did not influence decision to take raft trip	6	6

Some respondents were able to express a preference for a general flow level. These preferences are reported in Table 7-6. Note, however, that nearly half of all respondents (45 percent) did not state a preference. An interesting result presented in Table 7-6 is that only three percent of the respondents leaving from the Dam would have preferred a lower water level than they experienced, while 16 percent of those leaving from Lee's Ferry would have preferred lower water.

Table 7-6. Respondents' Evaluation of the Water Level During Their Raft Trip

Response	Proportion Checking Response Category	
	Dam	Lee's Ferry
Preferred lower water	3%[a*]	16%[b]
Preferred current level	28	28
Preferred higher water	13[a]	23[b]
Don't know or doesn't matter	56[a]	33[b]

* Statistics sharing a common superscript <u>are</u> <u>not</u> statistically different at the 0.05 level. Statistics with different superscripts <u>are</u> statistically different at the 0.05. For example, if two statistics both have an "a" in their superscripts, then they are not statistically different at the 0.05 level. Superscript notation is not used when statistical differences are not identified between any of the three groups of respondents.

These two proportions are statistically different. In addition, respondents from the dam were significantly less likely to state a preference for a flow level. Respondents who left from Lee's Ferry were also more likely to prefer higher water than were those leaving from the dam. These results suggest that respondents whose trips left from the dam may have been somewhat more satisfied with the flow level they experienced than were respondents whose trips left from Lee's Ferry, but that respondents from Lee's Ferry trips were not unanimous in their preferences for a flow level.

In summary, we concluded that none of the attributes of a Glen Canyon raft trip listed by respondents were sensitive to river flow levels. However, there was some tentative evidence that the origin of a raft trip may be a flow-sensitive attribute. That is, respondents whose trips left from the dam appeared to be slightly more satisfied with the flow level they experienced than were those who took a trip starting at Lee's Ferry. The primary objective of the contingent-valuation survey of Glen Canyon rafters, therefore, was to test for a statistically significant difference in surplus values according to the origin of the raft trips.

Contingent-Valuation Survey Procedures

Sampling. The sampling frame used for the Glen Canyon Day-Use Rafter CV survey was the same as was used for the attribute survey. The same sources were used to identify users from 1985, so the same limitations on the generalizability of survey results also exist for this sample. The final contingent-valuation survey (see Appendix J) was sent to a sample of 300 passengers.

As in the attribute survey, the sample was stratified into two groups according to the point of departure for the raft trip. This stratification allowed us to test for differences in respondents' surplus values according to the origin of their raft trips. A summary of the flow levels experienced by respondents to the contingent-valuation survey is presented in Table 7-7. The flow levels are comparable to what was reported in Table 7-1 for respondents to the Glen Canyon Rafters' Attribute Survey since the same sampling frame was used for both surveys.

Table 7-7. Daily Flow Levels Experienced by Respondents to the Glen Canyon Rafter Contingent-Valuation Survey

Flow	Trip Origin	
	Dam	Lee's Ferry
Average flow	25,600 cfs	39,200 cfs
Average high flow	28,000	41,000
Average low flow	21,900	36,300

Response Rate. For this survey, respondents were first contacted in July, 1986. Overall, 211 completed questionnaires were returned, 70 percent of the total sample. Twenty-seven questionnaires were returned incomplete because recipients made reservations in advance for a Glen Canyon raft trip, but did not take the trip. The response rate as a percent of all deliverable surveys and all individuals who had actually taken a Glen Canyon raft trip was 82 percent (See Table 7-8). The response rate did not differ significantly by the origin of respondents' raft trips.

Table 7-8. Glen Canyon Rafters CV Survey Response Rate

	Percent of Total Surveys	Percent of Deliverable Surveys**
Completed surveys	71%	82%
Undeliverables	4	--
Not applicable*	9	--
Refusals	2	2
Surveys not returned	14	16
TOTALS	100%	100%

* Respondents who pre-registered but did not actually take a raft trip.

** As noted in the text, 27 questionnaires were returned because the individual had not taken the trip. In addition, 12 questionnaires were undeliverable. Thus, the percentages in this column are computed from a sample size of 261 rather than 300.

The CV results presented in this section of the report are based on the responses of 200 Glen Canyon raft trip passengers: 104 passengers from trips leaving from the Dam, and 96 passengers from trips departing from Lee's Ferry. This number differs from the number of completed questionnaires received because the responses of three respondents who were younger than 18 years of age were not used, and eight questionnaires were received after the data analysis was completed.[2/]

2/ Eight surveys were received after the analysis of responses for this survey was completed. While these eight are included in the response rates for Table 7-8, they are not included in the results reported here.

Contingent-Valuation Survey

Given that the point of trip departure was the only important attribute identified by respondents as being potentially flow-sensitive, the contingent-valuation survey was designed to determine whether respondents' surplus values would vary according to the origin of their raft trip. Respondents were only asked to value their actual trip. Scenarios were not used because the attribute survey results indicated that Glen Canyon rafters were relatively insensitive to flow levels, and a sufficient number of observations on individuals from both types of trips could be obtained to make inferences about differences in surplus values according to this dichotomy.

All respondents were asked to value their actual trip using the same question format. Responses were then tested to determine whether a statistically significant difference existed between Lee's Ferry passengers and individuals who left from the dam. If a statistically significant difference was identified, it would be possible to conclude that large differences in flow levels do affect respondents' surplus values.

The mean actual trip expenditures across all respondents was $59. Average expenditures for passengers on trips departing from the dam and for Lee's Ferry passengers were $58 and $60 per trip, respectively, an insignificant difference. These expenditures included the payment to the rafting company, the purchase of any food and beverages for the trip not provided by the rafting company, and money spent on personal items such as suntan lotion or film for a camera.

The calculated surplus value for all respondents, in excess of the $59 they spent for their raft trip, is $26. This result implies that, on average, the cost of a Glen Canyon raft trip would have to increase by at least $26 before a typical respondent would choose not to take the trip. Analysis of the surplus values indicated that there was not a statistically significant difference depending upon the origin of trip (See Appendix O).[3/] Thus, we concluded that surplus values for a Glen Canyon raft trip are not affected by gross differences in flow release patterns from Glen Canyon Dam. This result indicates that if flow levels are such that raft trips in Glen Canyon are feasible at all, surplus values are constant across a variety of flow regimes.

3/ The calculated Chi-square statistic is 2.88 with 2 degrees of freedom, indicating that the null hypothesis of no difference can not be rejected at the 0.10 level.

Summary

The results of the attribute survey provided tentative evidence that the only flow-sensitive attribute of a Glen Canyon raft trip may be the origin of a respondents raft trip, i.e., whether an individual's trip departs from the base of Glen Canyon Dam or Lee's Ferry. Given this finding, the CV survey was designed to test for differences in respondents' surplus values according to the origin of their raft trip. The difference in surplus values was not statistically significant. Based on these analyses, we have concluded that flow levels, whether constant or fluctuating, do not affect surplus values for a Glen Canyon rafting experience.

It is our understanding, from discussions with representatives of Wilderness River Adventures and the Glen Canyon National Recreation Area, that the rafts used in Glen Canyon require two feet of water to run the river. This minimum water level would require a flow of 1,000 to 3,000 cfs. At the other end of the continuum, the maximum flow level for Glen Canyon raft trips is 46,000 cfs. This maximum is set by determining a break even number of passengers and then calculating a flow level beyond which the boat motors would not have enough power to carry this number of passengers upstream from Lee's Ferry. These minimum and maximum flows, from 1,000 to 46,000 cfs, cover the range of flow levels which the GCES were assigned to evaluate. Therefore, for all flow regimes that will be evaluated in the subsequent analyses in Chapter 8, Glen Canyon rafters' surplus values will be constant at $26 across all relevant flow levels.

CHAPTER 8

EVALUATION OF ANNUAL FLOW REGIMES FROM GLEN CANYON DAM

Introduction

Each GCES research team was asked to evaluate five annual flow regimes specified by the Bureau of Reclamation. The objective was to examine the effects of the specified release patterns on the resources being studied and to provide each research team with a basis for proposing alternative flow regimes. These analyses also help tie together the various components of the GCES by giving all teams the same flow regimes to assess.

The five flow regimes all involve 8.25 million acre-feet per year of water to be released. Actually, both recent experience and expectations regarding water use in the Upper Colorado River Basin states over the next several decades indicate that annual releases exceeding 8.25 million acre-feet will be common in future years. In addition to the five regimes with releases of 8.25 million acre-feet, two-high water flow regimes will be considered in this chapter. The goal will be to gain insights to the effects of high flows on recreation benefits. Finally, a flow regime that maximizes recreation benefits will be designed as a benchmark for comparison with more realistic flow regimes.

The objective of this chapter is to report how each of the flow regimes affect Glen Canyon fishing and Grand Canyon white-water boating. Since Glen Canyon day-use rafters' surplus values are constant across the flow patterns to be evaluated by the GCES, they will not be considered in this analysis.

At the beginning of this chapter, we review the flow value curves for constant and fluctuating flows for both anglers and white-water boaters. This review is followed by a section describing 1985 use rates for Glen Canyon anglers and Grand Canyon white-water boaters. The flow value functions and use rates are used to compute annual recreation benefits for each of the flow regimes. The results of this analysis are discussed and the effects of these flow regimes on angler and white-water boater surplus values are identified. Finally, we close with some suggestions regarding flow regimes that would be most conducive to Glen Canyon angling and Grand Canyon white-water boating experiences.

Flow Value Functions

In the preceding chapters we developed flow value functions for Glen Canyon anglers and Grand Canyon white-water boaters. For the latter group, separate functions were computed for commercial passengers and private boaters. For each group, a constant-flow function and a fluctuating-flow function were presented. A constant flow was defined as any average daily flow where the daily fluctuations would be less than 10,000 cfs. A fluctuating flow, in contrast, is an average daily flow which is associated with daily fluctuations of 10,000 cfs or more. This distinction is based on the results of the attribute surveys which indicated that a majority of respondents notice daily fluctuations in flow levels only when they exceed 10,000 cfs.

Moving to the flow value functions, Figure 8-1 shows that constant flow surplus values for commercial white-water passengers range from $47 per trip at 1,000 cfs to a maximum of $898 at 33,000 cfs, before declining to $732 at 45,000 cfs. Private white-water boater surplus values rise from $21 per trip at 1,000 cfs to a maximum of $688 at 29,000 cfs, and then decline to $376 at 45,000 cfs. Thus, commercial passenger and private boater preferences for constant flow levels, as measured by surplus values, are quite similar, with maximum values occurring at 33,000 and 29,000 cfs, respectively. Private boater surplus values, however, decline faster at flow levels above their optimum.

Figure 8-1 also shows the white-water boater flow value functions for fluctuating flow levels. Surplus values range from $198 and $224 per trip at 3,000 cfs to $446 and $373 at 25,000 cfs for commercial passengers and private boaters, respectively. At relatively low flow levels, less than an average daily flow of 10,000 cfs, fluctuating flow surplus values are higher than the corresponding constant flow values, while the converse holds at moderate flow levels above 10,000 cfs. Daily fluctuations of 10,000 cfs or more do not occur with average daily flows of less than 3,000 cfs or more than 25,000 cfs.

Flow value functions for anglers are shown in Figure 8-2. For constant flow levels, surplus values rise from $56 per trip at 1,000 cfs to a maximum of $126 at 10,000 cfs and then decline to $94 at 25,000 cfs and $38 at 45,000 cfs. The angler flow value function for fluctuating flows rises from $77 per trip at 5,000 cfs to $87 at 10,000 cfs, and then declines to $68 per trip at 25,000 cfs.

Figure 8-3 examines the flow value functions for constant flows for all recreationists simultaneously. This figure reveals the differences in flow preferences between white-water boaters and anglers. While anglers attain a maximum surplus value per trip at 10,000 cfs, the white-water boaters attain their maximums at 29,000 and 33,000 cfs, respectively, for private boaters and commercial passengers. Similar differences in preferred flows exist for fluctuating flows (Figure 8-4). It is also worth noting that surplus values per trip are much higher for white-water boating than fishing, particularly at moderate and relatively high flow levels. This

Figure 8-1

White-Water Boater
Flow Value Functions

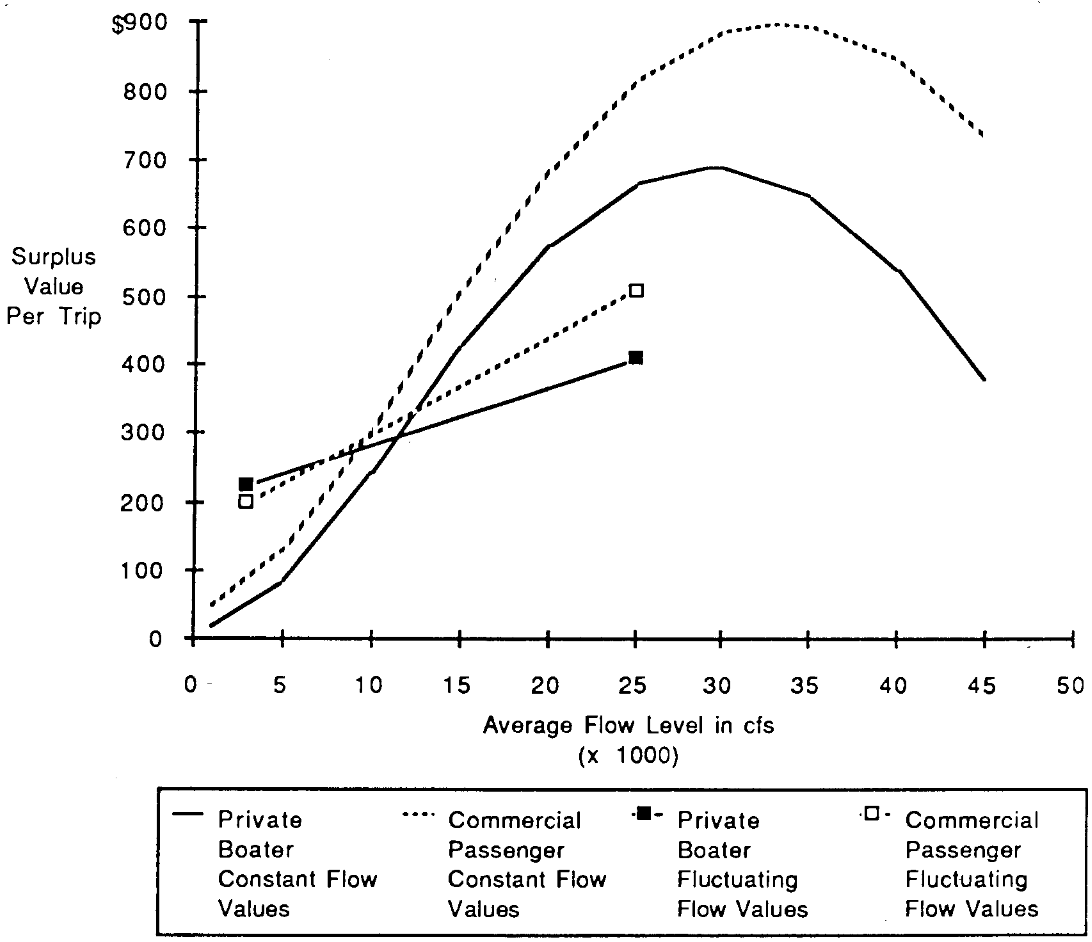


Figure 8-2

Angler
Flow Value Functions

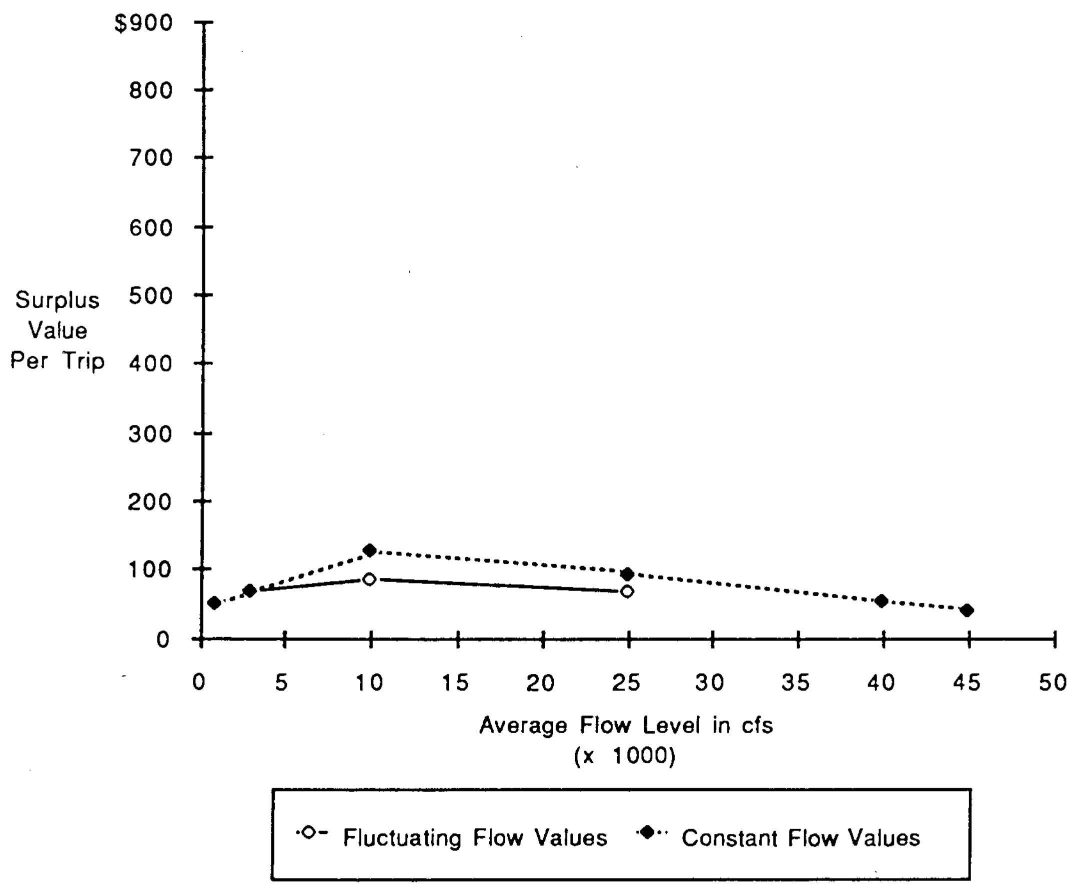


Figure 8-3

Flow Value Functions
(Constant Flows)

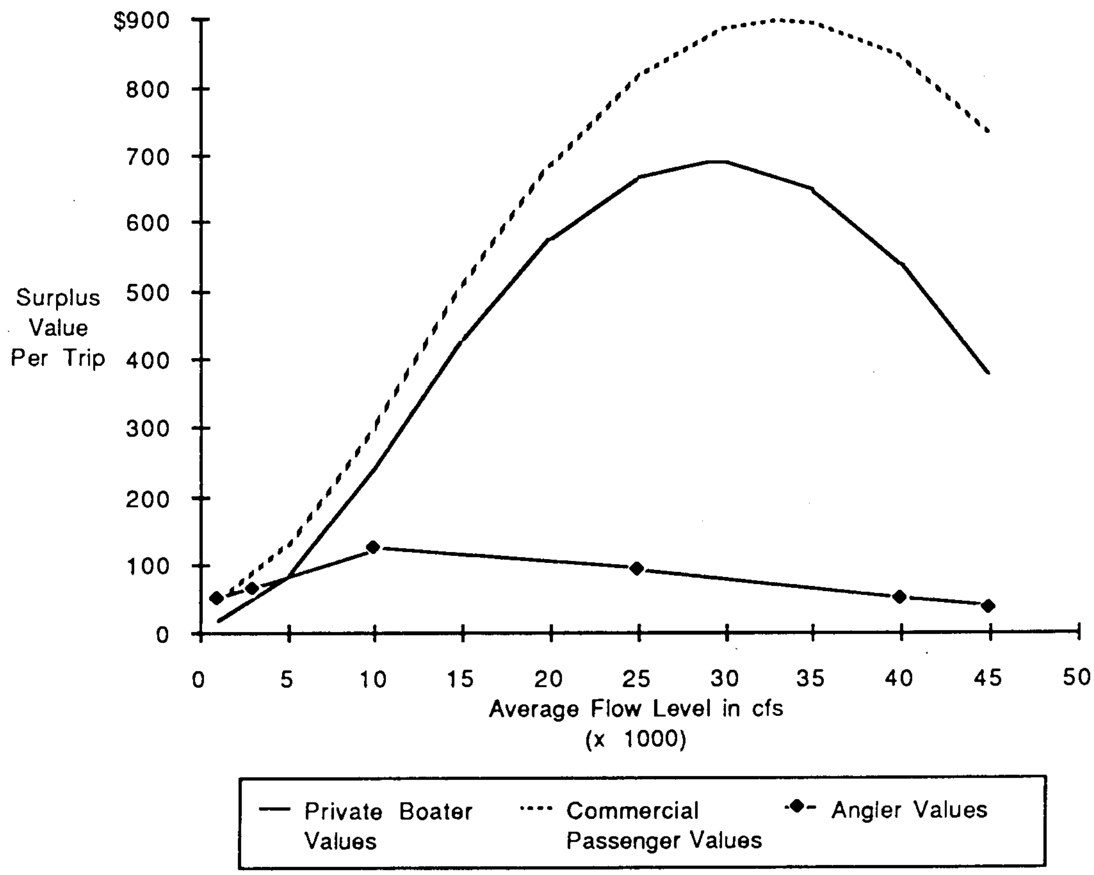
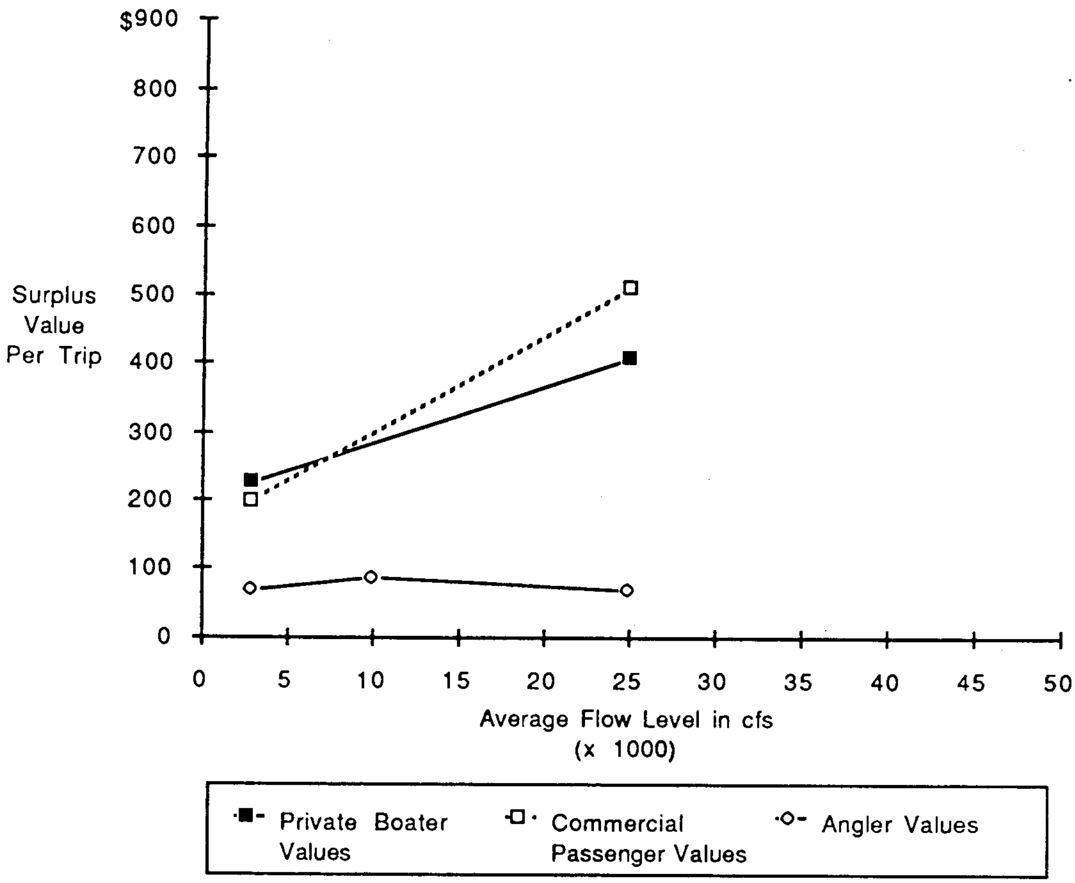


Figure 8-4

Flow Value Functions
(Fluctuating Flows)



reflects in part the larger number of days per trip for white-water boaters (8.8 days per trip for commercial passengers and 16.4 days per trip for private boaters) compared to fishing (2.5 days per trip).

The relationship between surplus values and average flow levels is one component of an analysis of the effects of annual flow regimes on angling and white-water boating. A second and equally important component of this analysis is the number of trips for each group. That is, in order to calculate the total recreation benefits for each user group as well as all recreation groups combined, it is necessary to know how many trips were taken in 1985.

White-Water Boater and Angler Use Rates

Information on 1985 use rates was obtained from Grand Canyon National Park for white-water boaters and from Glen Canyon National Recreation Area for anglers. These figures, as shown in Table 8-1, indicate that the majority of white-water trips in 1985 occurred in the months of May through September, while the primary angling seasons occurred in the fall (September thru November) and winter (January thru April). Patterns observed in 1985 were fairly typical, although as noted previously, total participation in fishing was much lower in 1985 than in previous years.

The difference in seasons of peak use are important given the substantial disparity in flow preferences of the two user groups. Moderate constant flows around 10,000 cfs would be conducive to angling in the fall and winter months and would not adversely affect the great majority of white-water boaters. In contrast, higher flows of 25,000 to 30,000 cfs or more during the summer months would be conducive to white-water boating without affecting the great majority of fishing trips.

Table 8-1. Grand Canyon White-Water Boating and Glen Canyon Angling 1985 Use Rates (Trips)

Month	White-Water Trips[a]		Angler Trips[b]
	Commercial Passengers	Private Boaters	
January	0	0	952
February	0	21	546
March	73	79	652
April	205	240	697
May	1,445	339	426
June	3,027	289	298
July	2,528	385	273
August	2,684	355	266
September	1,218	356	591
October	184	233	583
November	18	57	515
December	0	14	270
TOTALS	11,382	2,368	6,069

a/ Derived from National Park Service launch records.

b/ Glen Canyon National Recreation Area estimates the number of angler-days of participation each year. To get angler trips, we divided angler-days by 2.5 days per trip, the average trip length as determined in the Angler CV Survey.

Annual Flow Regimes Involving Releases of 8.25 Million Acre-Feet

The five annual flow regimes devised by the Bureau of Reclamation each specified average monthly flow levels and the ranges of daily fluctuations in flows. These five alternative flow regimes were designed to represent a variety of possible flow patterns that adhere to the physical, legal and administrative constraints of operating Glen Canyon Dam. Current water law requires that, on average, at least 8.25 million acre-feet per year must be released from Glen Canyon Dam. All five flow regimes involve annual releases of 8.25 million acre-feet. To simplify the analysis, flow patterns were assumed to be the same for all days within each month, but were allowed to vary from month to month.

The first three alternatives represent low to moderate average flows in all months with alternative types of fluctuations in daily flow levels (Table 8-2). Alternative 1 represents constant monthly flows ranging from 8,300 to 14,600 cfs. Such a flow pattern would result if the power plant was operated to generate base-load power. This alternative would be quite conducive to angling in Glen Canyon since angler surplus values are highest at constant flows of about 10,000 cfs, and values decline relatively slowly as flows increase or decrease from this point (see Figure 8-2).

The second flow regime also represented low to moderate average daily flows from 8,300 to 17,000 cfs, but with severe daily fluctuations. During June through August, daily flows could range from 3,000 to 33,500 cfs, and during the rest of the year daily flows could range 1,000 to 33,500. This is the type of daily flow pattern that would occur if the power plant were to be fully utilized for peak-power generation. Alternative 3 presents average daily flows that are the same as Alternative 2, but the fluctuations in daily flows would be moderate, ranging from 8,000 to 25,000 cfs, throughout the year. Alternative 3 represents a compromise between base-load and peak-load generation. For purposes of analysis, however, Alternatives 2 and 3 are exactly the same since any flow level with daily fluctuations in excess of 10,000 cfs is classified as a fluctuating flow for purposes of evaluating recreationists' preferences.

The fourth alternative represents extremely low average daily flows with large daily fluctuations throughout most of the year. The exception is high constant flows of 25,000 cfs during the prime white-water boating months of June through August. This regime mixes base-load generation in the summer with peak-load generation for the rest of the year. Of the four alternatives we have discussed to this point, it would appear that this alternative would present the best flow regime for white-water boaters.

The fifth, and final, alternative has relatively low average daily flows with daily fluctuations throughout the year. However, the range of fluctuations only exceeds 10,000 cfs in the months of April through October. Thus, anglers would receive constant flows throughout most of the prime fishing months.

In the next section, we will combine the surplus values and use rates for each user group to evaluate each of these five annual flow regimes. This will be done to determine which specific regime provides the highest recreation benefits to each group individually and all groups combined.

Table 8-2. Alternative Annual Flow Regimes

Month	Alternative 1			Alternative 2			Alternative 3			Alternative 4			Alternative 5		
	Average Flow	Range High	Range Low	Average Flow	Range High	Range Low	Average Flow	Range High	Range Low	Average Flow	Range High	Range Low	Average Flow	Range High	Range Low
January	14,600	14,600	14,600	14,500	33,500	1,000	14,500	25,000	8,000	11,400	33,500	1,000	8,000	10,000	6,000
February	12,200	12,200	12,200	9,500	33,500	1,000	9,500	25,000	8,000	5,400	33,500	1,000	8,000	10,000	6,000
March	8,300	8,300	8,300	8,300	33,500	1,000	8,300	25,000	8,000	4,900	33,500	1,000	8,000	10,000	6,000
April	10,300	10,300	10,300	9,700	33,500	1,000	9,700	25,000	8,000	5,000	33,500	1,000	12,600	33,500	1,000
May	10,000	10,000	10,000	9,000	33,500	1,000	9,000	25,000	8,000	4,900	33,500	1,000	12,200	33,500	1,000
June	10,400	10,400	10,400	9,800	33,500	3,000	9,800	25,000	8,000	25,000	25,000	25,000	13,400	33,500	3,000
July	12,750	12,750	12,750	17,000	33,500	3,000	17,000	25,000	8,000	25,000	25,000	25,000	17,000	33,500	3,000
August	14,400	14,400	14,400	16,500	33,500	3,000	16,500	25,000	8,000	25,000	25,000	25,000	16,500	33,500	3,000
September	10,000	10,000	10,000	10,200	33,500	1,000	10,200	25,000	8,000	8,400	33,500	1,000	13,400	33,500	1,000
October	9,900	9,900	9,900	9,200	33,500	1,000	9,200	25,000	8,000	4,900	33,500	1,000	9,300	33,500	1,000
November	9,800	9,800	9,800	9,400	33,500	1,000	9,400	25,000	8,000	5,000	33,500	1,000	8,900	10,000	6,000
December	13,600	13,600	13,600	13,400	33,500	1,000	13,400	25,000	8,000	11,400	33,500	1,000	8,000	10,000	6,000

Evaluation of Annual Flow Regimes for 8.25 Million Acre-Feet

To estimate the annual recreation benefits from the flow regimes, a computer model was designed that incorporates the flow value functions for white-water boaters and anglers. The model allows an analyst to specify average monthly flow levels and to designate whether the flow is fluctuating or constant. In addition, the analyst can choose to either apply 1985 use rates in the calculation of benefits or to specify other monthly use rates that may be appropriate for the analysis being conducted.

The calculations reported here are based on 1985 use rates. Thus, recreation benefits were calculated by specifying the average daily flows for each month of the year and whether the flows were constant or fluctuating. The model then calculates surplus values per trip from the flow value functions for each month, multiplies these values by the number of trips for that month in 1985 for each group and sums the monthly benefits to obtain an overall monthly benefit for all groups combined. Aggregate annual recreation benefits are derived by summing the monthly totals for each group individually, and all groups combined. A diagram representing the process for calculating total recreation benefits is presented in Figure 8-5.

Overall, Alternative 4 provides the largest aggregate recreation benefits for all three groups of recreationists combined, a total of about $9 million annually (Table 8-3). However, this alternative produces the lowest level of recreational benefits, about $0.5 million annually, for anglers.

Figure 8-5

Calculation of Annual Recreation Benefits for Alternative Flow Regimes

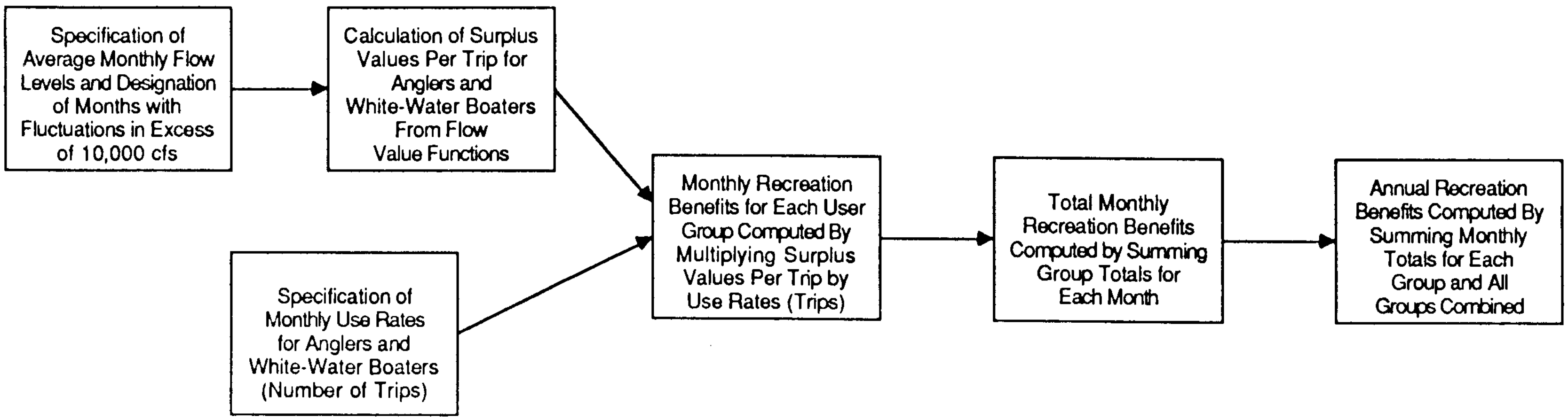


Table 8-3. Evaluation of Flow Regimes (Annual Flow = 8.25 Million Acre-Feet)

Alternative Annual Flow Regimes[a/]	White-Water Boaters: Commercial Passengers		White-Water Boaters: Private Boaters		Anglers		All Recreationists	
	Rank	Annual Benefits	Rank	Annual Benefits	Rank	Annual Benefits	Rank	Annual Benefits
1	2	$4,277,990	5	$ 681,178	1	$734,798	2	$5,693,965
2	4	3,846,816	3	706,345	3	508,499	4	5,061,661
3	4	3,846,816	3	706,345	3	508,499	4	5,061,661
4	1	7,478,301	1	1,017,161	5	482,451	1	8,977,913
5	3	4,126,982	2	723,729	2	584,146	3	5,434,858

a/ Flow regime 1 = Low to moderate constant average monthly flow releases

Flow regime 2 = Low to moderate average daily flows with extreme fluctuations

Flow regime 3 = Low to moderate average daily flow with moderate fluctuations

Flow regime 4 = High constant summer flows; low average daily flows, and extreme fluctuations from September-May

Flow regime 5 = Low to moderate average daily flows with extreme fluctuations from April-October.

Alternative 1 produces the highest benefits for anglers ($0.7 million annually) and the second highest total overall benefits ($5.7 million annually), but provides the lowest total benefits for private white-water boaters. These results reveal how commercial white-water boater preferences, as measured by surplus values, dominate the overall ranking of alternatives.

Examination of the rankings in Table 8-3 reveals some important effects of fluctuating flows. Recall that flow Alternatives 1 and 2 have similar average daily flows. However, Alternative 1 involves constant flows while Alternative 2 involves extreme fluctuations in daily flow levels. Recreational benefits for Alternative 2 are about 11 percent (approximately $0.6 million annually) below those for Alternative 1. At higher average daily flow levels during the peak boating season the effect of fluctuations would be larger.

It is also helpful to examine how each group ranked the alternatives. Let us start with the white-water boaters, remembering that Alternatives 2 and 3 are treated as being the same. Alternative 4 has the highest recreational benefits for white-water boaters, including both commercial passengers and private boaters. This result holds due to the constant flow of 25,000 cfs during the months where the heaviest use by white-water boaters occurs. The rankings of the other alternatives differ between these two groups primarily because private boater surplus values for fluctuating flows are substantially higher than those for constant flows which average less than 10,000 cfs.

Alternatives 1 and 5 generate the highest annual recreation benefits for anglers, because both have low constant flows around 10,000 cfs during the months when most of the fishing occurs. Alternatives 2 and 3 have lower annual angler benefits due to the fluctuating flows throughout the year. Alternative 4 produces the lowest total benefits for anglers due to the low average flows with extreme daily fluctuations during some of the good fishing months.

Alternative 4 produces the highest aggregate annual benefits when all three groups of recreationists are combined, due to the dominance of the commercial white-water boaters. The remaining four alternatives produce similar levels of aggregate annual benefits for all recreationists combined. The dominance of commercial white-water boaters is also represented in the rank of alternatives for all recreationists--the ranking for all recreationists is exactly the same ranking as that for commercial passengers.

Three High-Water Flow Regimes

Trip values used to evaluate the five 8.25 million acre-foot flow regimes were derived from surveys of 1985 visitors. Monetary benefits were calculated using estimated actual trips taken in 1985. Thus, the annual benefits were calculated as if 1985 had involved releases totaling 8.25 million acre-feet and this water had been released during the year in the manner postulated in the flow regime alternative being evaluated. Actually, not since 1982 have there been hydrological conditions anywhere close to those postulated in the five flow regimes. The 8.25 million acre-foot figure was used because this is the minimum average annual release from Glen Canyon Dam permitted under current water law. Now that Lake Powell has been filled, many experts believe that substantially more than 8.25 million acre-feet will be available for release in most years until well into the next century. The Upper Basin states are expected to have surplus water for several decades yet, except during drought periods. Furthermore, the Colorado River watershed produces greatly varying runoff, depending on annual precipitation. Recent years illustrate this well. During calendar year 1984, 20.8 million acre-feet were released from Glen Canyon Dam. In calendar year 1985, 16.6 million acre-feet were released. Even when the Upper Basin states are using their allocations fully, there will still be high water years. Under current conditions, Bureau of Reclamation experts predict that annual discharges from Glen Canyon Dam will exceed 8.25 million acre-feet in about three years out of four.

In this section, we will explore the implications of high water for recreation benefits. Evaluation of the 1985 release patterns is particularly interesting since 1985 data were used for valuation and participation. To assess the effects of extremely high water, 1984 will be evaluated as well. A third flow regime will also be developed which will be termed the "unconstrained optimal recreation flow regime." That is, we shall ask what sort of flow pattern would maximize recreational benefits given unlimited water and no other objectives or constraints. This is not to suggest that the system will be, or should ever be, operated solely for recreation. However, it will give us a useful baseline figure for the maximum benefits that could be earned if recreation were the only objective. Such a standard of comparison provides a context for considering total benefits from more realistic flow regimes.

In shifting from completely hypothetical flow regimes to the actual years 1984 and 1985, several simplifications are necessary. We will refer to the "1984 regime" and "1985 regime" to emphasize that the dam releases being valued are simplified versions of what actually happened. The valuation model holds average daily flows constant for each entire month. It also defines each month as a fluctuating or constant flow month using 10,000 cfs of variation per day as the dividing line. To accommodate this simplified framework, the 1984 and 1985 average monthly flows will be assumed to be fixed average daily flows for each month. To determine whether each month is a fluctuating or constant flow month, daily maximum and daily minimum flows were averaged over each entire month. If the average daily maximum for a month exceeded the average daily minimum by more than 10,000 cfs, the month was defined as one with fluctuating flows; otherwise it was defined as a constant flow month. Though resulting values will not be as exact as those that would come from a more complex model, they still should be good approximations of actual benefits. Table 8-4 shows relevant data for the 1984 flow regime, while Table 8-5 shows comparable figures for 1985. The total dam releases equaling more than 20.8 million acre-feet in 1984 and slightly less than 16.6 million acre-feet in 1985 were distributed as shown in these tables. In the 24 month period, only April, October, November, and December, 1985 qualified as fluctuating flow months. All others were classified as constant flow months.

Table 8-6 shows the calculated benefits for the three recreation groups separately and for all three groups combined under the two flow regimes just described. In order to hold all effects except flows constant, 1984 values are calculated using 1985 trips. This makes the 1984 regime fully comparable to all other flow regimes in this chapter. The results are quite interesting. Despite a difference of more than 4 million acre-feet of water released in the two flow regimes, the total benefits are quite close at just over $11 million. Furthermore, the total benefits of $11 million exceed total benefits from all of the 8.25 million acre-foot regimes evaluated in Table 8.3, where even the regime with the largest benefits (Alternative 4) yielded only about $9 million. The reason for the favorable economic results for high water years is that they entail fairly high constant flows in the May through September period when so much white-water boating occurs.

Lower water would, of course, enhance fishing benefits. This is apparent from comparing the 1984 or 1985 flow regimes where fishing benefits are about $525,000 to Alternative 1, Table 8-3, where fishing benefits are $735,000. At first glance, one wonders why the 1985 regime does not have significantly higher fishing benefits than 1984, given that average flows in October, November, and December are much more favorable to fishing in 1985. Closer examination shows, however, that any gains from lower average flows in these months are more or less balanced by losses due to daily fluctuations in flow levels.

Table 8-4. Data for Simplified 1984 Flow Regime

Month	Average Flow (CFS)	Average Maximum (CFS)	Average Minimum (CFS)	Acre-Feet Per Month
JANUARY	25,018	26,048	22,838	1,535,630
FEBRUARY	25,524	26,201	24,091	1,465,638
MARCH	25,447	26,339	22,427	1,561,964
APRIL	26,825	27,702	24,738	1,593,416
MAY	40,580	40,836	38,174	2,490,854
JUNE	41,167	41,713	39,728	2,445,347
JULY	35,387	36,678	34,725	2,172,087
AUGUST	26,312	29,166	23,151	1,615,053
SEPTEMBER	25,042	25,817	23,358	1,487,545
OCTOBER	22,966	24,151	21,253	1,409,696
NOVEMBER	25,635	26,165	24,435	1,522,722
DECEMBER	25,062	26,127	22,918	1,538,361
TOTAL				20,838,313

Table 8-5. **Data for Simplified 1985 Flow Regime**

Month	Average Flow (CFS)	Average Maximum (CFS)	Average Minimum (CFS)	Acre-Feet Per Month
JANUARY	26,121	26,657	24,749	1,603,347
FEBRUARY	26,929	27,550	25,739	1,492,978
MARCH	19,707	23,675	14,496	1,209,626
APRIL	20,015	24,751	13,157	1,188,891
MAY	32,884	34,251	27,821	2,018,455
JUNE	38,672	40,692	36,084	2,297,132
JULY	27,703	29,283	24,827	1,700,425
AUGUST	25,632	28,504	21,593	1,573,325
SEPTEMBER	22,929	26,783	18,412	1,361,984
OCTOBER	11,678	19,282	4,203	716,854
NOVEMBER	11,949	19,527	5,543	709,774
DECEMBER	11,214	20,282	1,789	688,338
TOTAL				16,561,129

Table 8-6. Evaluation of 1984 and 1985 Flow Regimes

Flow Regime	White-Water Boaters: Commercial Passengers	White-Water Boaters: Private Boaters	Anglers	All Recreationists
1984	$9,578,038	$1,471,946	$525,591	$11,575,576*
1985	$9,436,994	$1,359,037	$524,699	$11,320,727*

* Totals do not equal the exact sum of the components due to rounding.

Finally, Table 8.7 looks at an unconstrained flow regime designed to optimize recreational benefits. It assumes that water is available when needed in any quantity at any time. Constant flows are optimal in all months. The results indicate that 10,000 cfs would be optimal in December, January, and February. This is to be expected, since 10,000 cfs is ideal for fishing and there is very little white-water boating in these months. However, as soon as white-water boaters begin to appear in modest numbers, their dominance becomes apparent. The optimal flow for March, for example, is 26,400 cfs, despite the fact that there were only 152 white-water trips in March, 1985, while there were 651 fishing trips. May, June, July, and August all have optimal flows in excess of 32,000 cfs, reflecting the overriding economic importance of **commercial** white-water boating.

Total benefits to all three groups combined are slightly less than $12.4 million. This may be interpreted as an upper bound on recreational benefits that the system could have produced. No matter how the dam had been managed, the recreation benefits would not have exceeded this figure.

It is also interesting to compare the maximum possible benefits of $12.4 million with the benefits of $11.8 million and $11.3 million for 1984 and 1985, respectively. Even though dam releases were designed with little or no attention to recreation, recreational benefits were surprisingly close to the optimum. Implicit in all of this is the assumption that very high flows can be avoided. An example of extremely adverse circumstances occurred in 1983 when the reservoir filled completely and large amounts of excess water were released through the spillways. At one point, the flow reached 112,360 cfs. Safety became a major concern and white-water boating was halted for a time. Obviously, such floods are harmful to recreation, and the extent of the damage would not be fully reflected in a model such as ours that is based on averages and that is calibrated up to only 45,000 cfs.

Table 8-7. The Unconstrained Optimal Recreation Flow Regime[a/] (All Flows Constant)

Month	Average Daily Flows (cfs)	Acre-Feet Per Month
JANUARY	10,000	613,800
FEBRUARY	10,000	554,400
MARCH	26,400	1,620,432
APRIL	29,300	1,740,420
MAY	32,200	1,976,436
JUNE	32,800	1,948,320
JULY	32,600	2,000,988
AUGUST	32,300	1,982,574
SEPTEMBER	31,900	1,894,860
OCTOBER	29,400	1,804,572
NOVEMBER	24,500	1,455,300
DECEMBER	10,000	613,800
TOTAL		18,205,902

a/ Annual Benefits:

Commercial White-Water Boating	$10,197,556
Private White-Water Boating	1,590,312
Fishing	571,264
TOTAL	$12,359,132

Summary

This chapter has combined values per trip reported by white-water boaters and anglers, based on CV surveys of 1985 users, with the number of trips taken by each group to evaluate various annual flow regimes. Each regime portrays a simplified annual water release pattern that could result from Glen Canyon Dam and Power Plant operations, depending on hydrological conditions and operating procedures. Five regimes that would each result in an annual release of 8.25 million acre-feet were evaluated. Simplified regimes patterned after 1984 (a 20.8 million acre-foot year) and 1985 (a 16.6 million acre-foot year) were also evaluated. Finally, an unconstrained annual flow regime designed to optimize recreational benefits was designed and evaluated.

With annual releases totalling 8.25 million acre-feet to work with, white-water boaters and anglers compete for scarce water. From a recreational perspective, the more water that can be allocated to create high, constant flows in the primary white-water boating months of May through September, the greater the recreational benefits. Though not fully ideal from an economic viewpoint, this conclusion is illustrated well by Alternative 4 (Tables 8-2 and 8-3) which would have earned about $9 million under 1985 recreational conditions. This would not leave sufficient water to provide preferred fishing conditions during the rest of the year.

The best fishing regime (Alternative 1) would have earned only $5.7 million because there would not be enough water to provide good white-water boating conditions. Full utilization of Glen Canyon Power Plant for peak-power generation, as described in Alternative 2, would have produced even lower recreational benefits ($5.1 million) because of the adverse effects of daily fluctuations. Thus, when modest amounts of water are available, dam operations can have a major impact on recreation. Presumably this impact would be accentuated in drought years when less than 8.25 million acre-feet are available to be released.

While annual releases between 8.25 million acre-feet and 16.6 million acre-feet were not explicitly analyzed, the recreational implications of extra water are quite apparent. White-water boating and fishing tend to occur at different times of the year. The more water there is available, the more feasible it would be to accommodate both groups through relatively high flows in the May through September period and lower flows for the rest of the year.

Furthermore, extra water may make normal electricity generation and recreation more compatible. Release of the extra water involves periods of base-load power generation during the commercial white-water boating season when there are large potential recreation benefits to be earned from high constant flows. The implication of extra water for recreation benefits are illustrated by the $11.6 million that would have been earned by the 1984 regime and the $11.3 million that would have been earned by the 1985 regime. These are impressive benefit levels given that the maximum recreation benefits under ideal and unconstrained conditions would be about $12.6 million.

High water, such as that found in the 1984 and 1985 regimes, does create somewhat adverse conditions for fishing, but fishing benefits still would have exceeded $0.5 million for both regimes. The flows for the primary fishing months (September through April) were still mostly in the 20,000 cfs to 30,000 cfs range. Though not ideal, the "flatness" of the fishing flow value curves means that trips under such flows are still fairly valuable, particularly if fluctuations are avoided. High water certainly decreases fishing benefits, but the effect was no more severe than, for example, adopting a peaking regime in an 8.25 million acre-foot year.

CHAPTER 9

CONCLUSIONS

The purpose of this study was to assess the impacts of various releases of water from Glen Canyon Dam on downstream recreation. Minimal releases of 1,000 cfs are possible at any point in time unless the reservoir is completely full. At the other extreme, operating all eight turbines at Glen Canyon Power Plant releases as much as 33,500 cfs. Furthermore, it is possible for flows to fluctuate across this full range (1,000 to 33,500 cfs) on a daily basis, if the power plant were operated for maximum peak power generation. Additional water can also be released through bypass tubes and, if the reservoir is full, through spillways. Even after allowing for technical and institutional constraints on dam operation, many dam release strategies are feasible. The effects of dam releases on downstream recreation may be very different depending on which strategies are chosen in the future. The purpose of the research reported here was to better understand and quantify these effects. Some conclusions are drawn below.

White-Water Boating Conclusions

Conclusion 1: Glen Canyon Dam releases have substantial impacts on white-water boating. The attribute survey of this group showed that several important attributes of white-water trips are affected by flows. Time at attraction sites and for layovers depends on the speed of the current. The size and number of rapids are also affected by dam releases.

Boaters, particularly those on commercial trips, enjoy fairly large rapids that depend on substantial amounts of water in the river. At relatively low or high flows, passengers--particularly those on commercial oar trips--may have to walk around rapids, and this is generally considered a negative attribute. High water may raise concerns about safety in the minds of some boaters. The lack of crowding is important to many boaters, and high water can also contribute to crowding at campsites and attraction sites. Litter is a negative attribute that is reduced by occasional periods of very high water. The attribute survey indicated a preference for medium to high flows in the 16,000 cfs to 32,000 cfs range.

The survey of commercial trip guides and private trip leaders indicated general agreement with the attribute survey results. For example, guides and trip leaders agree that flows on the low and high ends of the spectrum do increase the odds that passengers will have to walk around rapids. Safety also becomes more of a concern at low and high flows. Guides and trip leaders agree that low flows reduce the time available for attraction sites and time in camp. High flows create extra time for such activities. Guides and trip leaders also believe that the number and size of campsites are limited at high water. Overall, most guides and trip leaders have a preference for medium to high water in the range between 16,000 and 30,000 cfs.

The contingent-valuation survey also supports the conclusion that the white-water boating experience is affected by flows. For constant-flow trips, where there were actual-trip data across a wide range of flows, the average flow actually experienced was a statistically significant and potent predictor of surplus values.

Surplus values are much larger for medium-high flows in the 25,000 cfs to 35,000 cfs range than for lower and higher flows. Fluctuating flow values based on respondents' evaluations of scenarios also support this relationship. Based on the economic analysis, the ideal flow for commercial trips is about 33,000 cfs, while for private trips it would be roughly 29,000 cfs.

Conclusion 2: Except at low average daily flows (less than 10,000 cfs), fluctuating daily flows are detrimental to white-water boating when compared to constant flows at the same average daily levels. One of the primary attributes of a white-water boating trip is experiencing the natural environment of Grand Canyon National Park. Perceptible fluctuations in water (roughly speaking fluctuations of 10,000 cfs or more) make the canyon seem less natural to most participants. Allowing for changes in water level makes camping and mooring of boats for the night more difficult as well. Fluctuations also increase the likelihood of arriving at rapids at disadvantageous times when waiting for water level changes or walking around may be necessary.

Guides and trip leaders in general agreed that lower fluctuations are more desirable than higher fluctuations. Larger fluctuations tend to reduce time available for stops at attraction sites and in camp, increase the necessity of scouting rapids and checking boat moorings during the night, and increase the difficulty of planning itineraries. Guides find larger fluctuations more tolerable the higher the average daily flow, but a large share of them would consider the possible fluctuations between 1,000 cfs and 33,500 cfs associated with full use of Glen Canyon Dam for on-peak power generation "intolerable."

Not surprisingly, except for the low flows discussed below, when trips with the same average daily flow were compared, those with constant flows produce larger surplus values per trip than those with fluctuating flows. For example, based on scenario values, fluctuating flows around an average daily flow of 22,000 cfs would produce a 27 percent lower surplus value for private trips and a 22 percent lower surplus value for commercial trips compared to constant flow trips at that level.

At low flows, this relationship is reversed for commercial passengers. Based on respondents' evaluation of scenarios, willingness to pay is significantly larger for fluctuating flows around an average daily flow of 5,000 cfs than for constant flows at that level. Presumably, this reflects a desire to have higher water for at least part of the day. It should be noted, however, that there was no such difference for private trips. For the 5,000 cfs scenarios, the private trip surplus values for constant and fluctuating flows were statistically indistinguishable.

Conclusion 3: Annual white-water boating benefits could be enhanced most by maintaining relatively high constant flows during the summer months. About 67 percent of all white-water boating trips (both commercial and private) occur during June, July, and August. High stable flows in the range of 25,000 to 33,500 cfs would produce high benefits per trip. For example, commercial benefits per trip at 33,000 cfs are nearly $900, whereas they fall to only about $300 at 10,000 cfs. Thus, high flows in the summer could increase commercial white-water boating benefits by as much as three times or more compared to low flows. Though slightly less pronounced, the same conclusion applies to private trip benefits. Further gains could be achieved through high and stable flows in May and September when an additional 25 percent of the trips occur.

Conclusion 4: Very high flows (in excess of 40,000 cfs) will reduce white-water benefits, particularly during June, July, and August. The flow value functions for both private and commercial trips decline sharply after their respective maximum points. For example, commercial benefits per trip at 45,000 cfs are almost $170 lower than the maximum of nearly $900 per trip at 33,000 cfs. This represents a decline of nearly 19 percent. The decline is even steeper for private trips. From a maximum of $688 reached at 29,000 cfs, private benefits decline to $376 per trip at 45,000 cfs, a decline of 45 percent (see Figure 5-1). Such losses would be largest in the summer months of June, July and August, but this potential loss in benefits is also a concern in May since May is a month when the bypass tubes may be utilized along with full capacity operation of the power plant in years of high upstream run-off. Full operation of the power plant and bypass tubes involves flows of around 50,000 cfs.

Conclusion 5: Loss of large numbers of camping beaches would have a substantial adverse impact on white-water boating. Sandy beaches provide the best camping sites in the canyon because they are relatively flat and free of dense vegetation and rocks. Currently, some stretches of the river have few beaches. This requires some planning on the part of guides and trip leaders to assure passengers a good place to spend the night in these areas. Time at attraction sites may be cut short or some sites may have to be skipped altogether. Parties may have to leave earlier in the morning or spend more time rowing or motoring to reach good campsites in certain stretches of the river.

Some concerns have been voiced about the effects of dam operations on beaches. Glen Canyon Dam has cut off a source of sediment for beach deposits and high flows may increase erosion rates for existing beaches. Other research teams within the Glen Canyon Environmental Studies are examining the processes which affect beaches and the extent to which beaches are threatened under alternative flow regimes. Their results, however, are not available to us at this time. Our results do indicate that if dam operations result in substantial reductions in the number or size of beaches in the future, the damage to recreational benefits would be substantial. In economic terms, trip values could well be reduced by one-third or more.

Furthermore, an important difference exists between the short-term effects of flows, as discussed in the previous conclusions, and the potential effects of beach losses. With the possible exception of litter cleanup from high flows, all of the effects of flows discussed previously are felt only by those engaged in recreation at the time the flows are occurring. Such effects are transitory in the sense that different flows can produce different effects a week, a month, or a year later. This year's dam operating procedures do not affect next year's recreational benefits through these transitory effects. If flows cause permanent destruction of beaches, however, the results are not transitory, but irreversible. Barring new technologies to economically move large quantities of sand into the system, flow release patterns that damage beaches today would affect the recreational experience into the indefinite future.

Glen Canyon Fishing Conclusions

Conclusion 6: Glen Canyon Dam releases have a substantial impact on the value of the fishing experience downstream. The attribute survey of anglers, along with expressed opinions of guides and resource managers, indicated that two attributes of fishing trips are important and are sensitive to flows. First, the overriding goal of Glen Canyon anglers is to catch fish, and the possibility of catching trophy-sized fish is particularly important. Glen Canyon anglers may enjoy the fresh air and scenery as well, but they are primarily interested in catching fish. Second, flows influence how easy it is to handle a boat and the risk of damaging boats and/or motors.

It should be remembered at this point that our study was conducted without any information regarding the effects of alternative flow regimes on the long-term productivity of the fishery. Another team of researchers under the GCES is attempting to identify the long-term relationships between biological productivity and dam operations. However, our study was conducted without the benefit of their results. This study focused on the short-term impacts of flows.

Given some number and size distribution of fish in the river, flows may still affect the ability of anglers to catch the fish. Of course, anglers' views on the nature and extent of these effects are based on their rather subjective perceptions rather than scientific evidence, but this did not preclude the economic analysis. Many economic values are based on subjective perceptions.

While anglers vary in their opinions about what flows make for good and poor fishing, the attribute survey did identify a tendency to favor moderate flows in the neighborhood of 10,000 cfs. To some extent, this is a compromise. At low flows, fish are concentrated and may be easier to find. However, at very low flows of 3,000 cfs or less, it is difficult or impossible to get boats upstream. Also, as flows fall farther below 10,000 cfs, there is an increased risk of damage to boats and motors due to shallow water over unseen rocks and gravel bars. At higher flows, fish become more dispersed and may be difficult to locate. The current becomes more swift and this makes fishing more difficult. At relatively high flows, say 25,000 cfs, boats with low horsepower have trouble going upstream against the current. Also, bank anglers begin to encounter difficulties as the water floods low lying areas along the river bank. While higher water may reduce the chances of damaging boats and motors on submerged rocks, the chances of swamping boats increases as anchors are dragged in the swift current. In the past, when flows reached 40,000 cfs, the National Park Service has required boats to have at least 25 horsepower motors.

This tendency to favor moderate flows was also supported in the CV survey results. Surplus value per trip doubles (from $60 to $126) between the 3,000 cfs and the 10,000 cfs constant flow scenarios. The value then declines by 25 percent (to $94) for 25,000 cfs. At 40,000 cfs, the value drops by another 33 percent (to $52) below the maximum value. A similar, though less dramatic tendency exists for fluctuating flows.

Conclusion 7: Except at low average daily flows, most anglers prefer constant flows to fluctuating flows. Fluctuations have several disadvantages that many anglers are concerned about. Large fluctuations mean that anglers may have to operate part of the day at low or high flows with all the previously mentioned disadvantages of both. Furthermore, changing water levels add additional difficulties. Falling water may make it difficult to get downstream over rocks and gravel bars that were more submerged on the trip upriver. Rising water increases the likelihood of swamping a boat while anchored or while the bow is pulled up on shore along the river. A few anglers favor fluctuating flows because they believe that rising water may stimulate feeding of the fish. Nevertheless, preferences, as expressed in both the attribute and CV surveys, clearly indicate that a majority of anglers feel the disadvantages of fluctuations outweigh the advantages. In monetary terms, fluctuations can reduce surplus values by as much as 30 percent compared to constant flows with the same daily average.

As in the case of white-water boating, this general conclusion about the detrimental effects of fluctuations does not hold at very low flows. For fishing, the surplus value per trip for 3,000 cfs with fluctuations was not statistically different from the 3,000 cfs constant flow scenario value. Perhaps for the average angler, the disadvantages of fluctuations at such low average daily flows are balanced by the advantages of having higher flows for at least part of the day.

Conclusion 8: Annual angling benefits could be enhanced most by maintaining moderate to low constant flows in the range around 10,000 cfs in the nonsummer months. This conclusion is based on the fact that fishing is highest during the nonsummer months of September through May. During 1985, for example, 86 percent of the angler trips occurred during the nonsummer months. Some modest fluctuations would be consistent with this conclusion, but flows less than 5,000 cfs or greater than perhaps 20,000 cfs would significantly reduce surplus values. Interestingly, with the exception of May and September, the months when fishing participation is highest are the months when white-water boating is lowest.

Conclusion 9: In managing releases from Glen Canyon Dam, effects on the productivity of the downstream fishery could have large recreation effects. As noted previously, our analysis was done without the conclusions from GCES research on the relationships between flows and fishery productivity. We are nevertheless able to conclude that productivity is a major issue from an economic standpoint. If dam management could help restore the trophy fishery in Glen Canyon, the annual benefits from the fishery could easily double or more, based on increased surplus value <u>and</u> increased participation. If dam management contributed to a loss in productivity, equally dramatic effects in the opposite direction could be sustained. Both the history of the fishery and our CV results testify to the economic volatility of this fishery.

Glen Canyon Day-Use Rafting Conclusions

Conclusion 10: Glen Canyon Dam releases do not appear to have significant impacts on day-use rafting over a very broad range of flows. As explained in Chapter 7, neither the attribute nor the CV surveys succeeded in identifying significant effects of stream flows on the quality of this activity. In particular, the possible effects of departing from Lee's Ferry rather than the Dam, as generally becomes necessary at flows greater than 29,500 cfs, were examined, but no statistically significant impacts were identified. Only if flows were so low or so high that trips had to be curtailed altogether would day-use rafting be adversely affected by flows. Then, the loss in surplus value would be about $26 per trip lost.

Conclusions From Combining White-Water Boating and Fishing Values

Conclusion 11: 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. The unconstrained optimal flow regime presented in Chapter 8 suggests that flows in excess of 30,000 cfs are ideal from May through September. Since there is little or no white-water boating in December, January, or February, and fishing participation is high, constant flows of 10,000 cfs are ideal in these months. The remaining months involve substantial compromising between the two groups. Because of its potentially high value per trip and the sensitivity of the trip values to flows, white-water boating would tend to predominate if such compromises were made on the basis of surplus values. Thus, the unconstrained optimal flow regime dictates flows in the 20,000 cfs to 30,000 cfs range in March, April, October, and November.

To fully meet the requirements of the unconstrained optimal regime over a 12-month period would require better than 18.2 million acre-feet of water. Obviously, such a large amount will not be available in most years. Even if other objectives such as water storage and electricity generation could be ignored, compromises between white-water boaters and anglers would still be necessary in most years. Analysis of the 8.25 million acre-foot regimes indicated that if such compromises were based on recreational surplus values alone, considerable emphasis would be placed on providing high, constant flows in the summer months to benefit white-water boating even though this would entail losses in fishing benefits. While a model to calculate constrained optimum flows for recreation does not yet exist (see discussion in the next section), we can use what we know to speculate on what such a flow regime would look like when water is too scarce to fully reach an unconstrained optimum. Flows during December, January, and February would be below 10,000 cfs in order to provide more water for the summer months. During the summer months, flows would be constant at 25,000 cfs or more. In the remaining months, flows would lie in between.

Conclusion 12: Trade-offs between white-water boating and fishing, and, in a broader sense, between recreation and other objectives are likely to be less severe the more water is available. More water, up to 18.2 million acre-feet per year if managed properly, makes it more feasible to improve total benefits for white-water boaters and anglers combined. Losses to anglers from higher water can be more than counter balanced by gains to white-water boaters. Second, as we learned from examining the 1984 and 1985 regimes, high water (less than 40,000 cfs) means long period of high, constant flows during May and June and possibly beyond. Historical dam operations during periods of high runoff are thus conducive to a high level of white-water boating benefits, yet adverse impacts on fishing are not extreme.

Conclusion 13: In general, extreme flow levels will adversely affect recreation. In this regard, there is no disagreement between white-water boaters and anglers. Very low flows in the 1,000 to 5,000 cfs range are disagreeable to both groups as are flows in excess of 40,000 cfs. Also, extreme daily changes, such as daily fluctuations between 1,000 cfs and 33,500 cfs would have substantial adverse effects on both.

Conclusion 14: Recreation benefits could be compared to power benefits, properly calculated, but recreation benefits reported here are not directly comparable to power revenues. Comparison of recreation and power benefits is beyond the scope of the current study, but a few comments and words of caution are warranted. There will be a natural tendency to ask whether the recreation benefits as calculated in Chapter 8 are larger or smaller than the power benefits from Glen Canyon Dam. This is a legitimate question from an economic point of view. It is also a complex question that would require a major research effort to answer. Glen Canyon Dam and Power Plant are part of a much larger system and it would be necessary to understand their economic role in that system before power benefits could be estimated. Also, it would be important to focus on what economists would call "changes at the margin." The issue would not be the total benefits of power from Glen Canyon Dam compared to the total benefits of recreation. Rather, the analysis would have to focus on how power and recreation benefits change with alternative dam management strategies. This whole analysis would have to be conducted using standard benefit-cost concepts.

However, one conclusion about recreation and power benefit comparisons is abundantly clear without further analysis. The recreation benefits calculated in this study are not comparable to power revenues in any economically meaningful sense. The rates which the government charges for power from facilities like Glen Canyon Dam are, by law, based to a considerable degree on the costs of the project, not its benefits. The goal, then, is to obtain enough revenues to cover the so-called separable costs of the power plant and associated facilities. Thus, the cost of the power would not be a good indicator of the benefits that are attributable to it. Comparing power revenues to recreation benefits is like comparing apples and oranges. The results of such a comparison would have no relevance whatsoever for economically sound management of the dam.

Some Final Thoughts

Stepping back from specific conclusions and viewing this study in a broader context indicates several avenues for future research. As in any research endeavor, much remains undone. Before looking to the future, however, it is worthwhile to review some of the noteworthy features of the current research.

To begin with, the link between attribute surveys and CV surveys utilized here is, so far as we know, a new approach to valuation research. We at HBRS cannot claim credit for this innovation. It was built into the study design prior to our involvement. Attribute survey results provided a strong basis for the CV questions, particularly those involving scenarios when the CV results were obtained, and the expressions of preferences from the attribute surveys provided valuable cross-checks for the relationships between flows and trip values implied in the CV responses. As such, the attribute surveys provided substantial support for the validity of the CV results. Serious discrepancies between the attribute results and the CV results would have indicated that the CV results might have serious problems that required further attention. We expect to see more studies in the future that exploit the complementarity between attribute surveys and CV surveys.

In evaluating any CV study it is important to ask whether state-of-the-art survey methodology and CV techniques were applied. The surveys conducted in this study were carefully designed and pretested by experienced survey researchers. Sampling strategies had to be adapted to the characteristics of the recreational activities being studied and the needs of the supporting agencies for relatively quick results. Other constraints such as the prohibition on interviewing in Grand Canyon National Park had to be honored. Within these constraints, we have no misgivings regarding the sampling procedures used in this study. The final versions of the mail surveys were administered with sufficient follow-up contacts to assure high response rates. The CV questions themselves were designed and implemented based on the latest research on the subject, with particular emphasis on simulated market contingent-valuation comparisons. Data were carefully computerized and analyzed. In sum, we believe that this study represents the current "state-of-the-art" in valuation research.

Also noteworthy is the use of both actual trip values and scenario values in this study. Most researchers in the field would probably agree that values based on actual experiences are superior. We would concur, and we used actual trip values for constant flow white-water boating and day-use rafting trips. However, obtaining valuation data for a sufficient range of conditions actually experienced is not always feasible. Words in a scenario are probably not a perfect substitute for an actual experience. However, based on comparison of actual experience values and scenario values for both commercial and private white-water boaters, they seemed to be an acceptable substitute in this case.

Finally, the present study is noteworthy in the extent to which it carries the research forward into the analysis of actual policy options. Unfortunately, a great many CV studies stop with the value per trip or per person, leaving the task of interpreting the policy implications and recommendations to others. Thanks to the support provided by the Bureau of Reclamation, we were able to value a number of annual flow regimes in Chapter 8 and include relevant conclusions from that analysis in this chapter. This is a significant step toward a full and correct assessment of the implications of our results for use in policy discussions.

One area in which future research is needed is the relationship between participation, flows, and fishing success. Based on our scenarios, we were able to estimate how surplus value per trip changes with flows, but were unable to deal satisfactorily with how the number of fishing trips would change. The volatility of participation in this fishery has been stressed repeatedly in this report, as has the potential value of a rehabilitated trophy fishery. However, full evaluation of the potential implications of a changed fishery would require a good participation model. Some investigation of how the values reported here have been affected by the lures-only regulation, introduced in 1986, would also be desirable. Participation was not an issue for white-water boating because of the National Park Service's present restrictions on launch schedules.

Returning for a moment to the apparent superiority of CV values based on actual experience compared to those based on scenarios, it is worth remembering that we were generally precluded from obtaining experience-based values by dam release schedules during this study. Only in the case of white-water boating constant flow values was there sufficient variation in actual flows experienced to allow us to use actual trip values. Future research should re-evaluate the fishing and white-water boating experiences under actual conditions of constant and fluctuating flows. Particular attention should be given to the effects of fluctuations. The definition of fluctuations used in this study, changes in flow of 10,000 cfs or more, is obviously very crude. A 10,000 cfs fluctuation around an average daily flow of 7,000 cfs is obviously very different from a 10,000 cfs fluctuation around a daily average of 20,000 cfs, whether one is fishing or rafting. Furthermore, a 10,000 cfs fluctuation at the dam will not have the same impact on a white-water boater a hundred miles down the river as it will just below Lee's Ferry. A useful first attempt at analyzing fluctuating flow values has been made in this study, but much more could be done.

More could be done on the modelling side as well. The unconstrained optimal recreation regime discussed in Chapter 8 was determined heuristically, the problem is clearly amenable to more formal procedures. Constraints could easily be added to form a nonlinear programming problem. One simple constraint would be the total releases over a 12 month period. In this way an optimal release scenario for any given quantity of water could be defined. Once again the objective would not be to directly prescribe dam operations. Instead, such a model would define a constrained optimal recreation scenario for comparison with alternative plans designed to meet a broader range of objectives. If the optimum flow regime for a given annual number of acre-feet would produce say, $11 million in recreation benefits, while an alternative proposed for actual implementation would have $10.5 million, then the adverse recreational impact could be considered slight. If the alternative has benefits of $6 million, then perhaps another alternative, less harmful to recreation, could be sought.

Additional constraints could be added to such a model. Constraints on dam storage capacity and the seasonality of runoff would allow the model to more closely simulate dam operations.

The valuation model itself could be refined in many ways. Instead of monthly data, a more sophisticated model might be developed to deal with weekly, daily, or even hourly data. Hydrological models under development elsewhere in the GCES might be adapted to trace downstream river conditions resulting from dam operations. Another part of the GCES experimented in a preliminary way with a simulation model of white-water boating but more research would be needed before a recreation simulation model and an economic evaluation model could be linked.

Finally, looking beyond research on recreation alone, future research could evaluate the trade-offs between electric power production at Glen Canyon Dam and downstream recreation. As noted under Conclusion 14, such a comparison would require an adequate characterization of the power generation and transmission network that absorbs Glen Canyon power. The emphasis would be on power benefits, **not** power revenues. The power valuation model and the recreation valuation model would have to match up in terms of how water releases from Glen Canyon Dam were characterized.

Enough has now been said to verify that a great deal remains undone. Still, the research reported here does represent a solid step forward in understanding how recreation between Glen Canyon Dam and Lake Mead is affected by dam operations. To some extent, this research was needed to establish the value of recreation compared to the more institutionalized goals of water supply and power generation. Glen Canyon Dam operations can have positive or negative effects on recreation that are worth millions of dollars. Furthermore, our research constitutes a new and powerful basis for integrating recreation into the decision process. Few would advocate that national environmental assets like the Grand Canyon be managed for dollars alone, but dollars can be used to quantify some of the effects of flows on the recreational environment. Such quantified effects are rich in insights that could prove useful in future decisions regarding Glen Canyon Dam operations.

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GLOSSARY

Angler Day: A visit to engage in fishing for one calendar day.

Attribute Survey: A survey used to identify the important flow-sensitive characteristics (or attributes) of each recreational experience.

Average Daily Flow: The average amount of water, measured in cubic feet per second (cfs), released from Glen Canyon Dam over the course of a 24-hour period.

Base-Load Generation: Operation of a power plant at constant levels of output over periods of more than one day, in order to contribute to the minimum constant amount of load of the power system.

Constant Flow: In this study, a constant flow occurs when dam releases do not vary more than 10,000 cfs over a 24-hour period. This term is used in contrast to fluctuating flow, as defined below.

Contingent Valuation: This is a technique for valuation of nonmarket goods, such as outdoor recreation. People are asked in surveys about the value they would place on the good if a market or other means of payment existed. All transactions are hypothetical.

Contingent-Valuation Survey: A survey used to quantify the effects of different flow release patterns, as measured in dollar terms, on each recreational experience.

CV: Contingent valuation as defined above.

Dichotomous-Choice Questions: A technique of asking contingent-valuation questions where each respondent is asked whether she or he would be willing to pay some specified offer amount (defined below), and can answer either yes or no. Offer amounts are randomly assigned and varied from respondent to respondent, so that data for a full range of values can be obtained.

Expenditures: In recreation economics, expenditures are the amounts of money people actually spent to take a recreational trip. In recreation valuation, expenditures often take the place of market value (defined below).

Flow Regime: A description by month of releases from Glen Canyon Dam over an entire year, including average daily flows and whether such flows are constant or fluctuating flows as defined elsewhere in this glossary.

Flow Scenario: A description of the implications of a specified flow for fishing or white-water boating used as part of some contingent-valuation questions in this study.

Flow Value Function or Curve: A function stated mathematically or plotted in a graph that expresses the relationship between surplus value per trip (defined below) and average daily flow (defined above).

Fluctuating Flow: In this study, a fluctuating flow occurs when dam releases vary more than 10,000 cfs over a 24-hour period. This term is used in contrast to constant flows as defined above.

Hedonic Price Method: A technique for inferring values of nonmarket goods from market values of related goods. For example, property values in several areas with varying air quality might be analyzed to estimate how much people would be willing to pay for cleaner air.

Hypothetical Bias: This is a catch-all category of potential distortions in contingent-valuation results. The common thread running through this category of bias is that distortions are **unintentional.** That is, because people have never before been asked to express their preferences for nonmarket goods in monetary terms and because CV involves only hypothetical transactions, study participants may not know their surplus values and may not give accurate estimates of their values. This is in contrast to strategic bias, defined below, where distortions are intentional.

Logit Equation: In contingent valuation, logit equations are used to analyze dichotomous-choice (defined above) data. Logit equations characterize the relationship between the offer amount (defined below) and the probability that offer amount will be accepted. See Appendix L, M, N, and O for more complete details about logit functions, how they are estimated, and how values are derived from estimated logit equations.

Market Value: In benefit-cost analysis of projects or policies affecting market goods, market value is the quantity of the good produced multiplied by market price per unit.

National Economic Development (NED) Benefits: Benefits evaluated from the point of view of the nation as a whole (as opposed to regional benefit, defined below). Benefits in this study are evaluated from the NED perspective.

Offer Amount: In this study's dichotomous-choice questions (defined above), respondents (i.e., white-water boaters, anglers, and day-use rafters) were asked whether they would take a specified trip (an actual trip or a trip described in a scenario) had their expenses been larger by some specified amount. This specified amount is sometimes referred to as the offer amount.

Peak-Load Generation: Operation of a power plant at levels which vary greatly within a 24-hour period in order to help satisfy relatively high power demands that typically occur for short periods.

Recreation Day: A visit during one calendar day.

Regional Economic Development (RED) Benefits: Benefits evaluated from the perspective of one region within the nation. These benefits were also referred to as "local economic impacts" in this report. This study adopted a National Economic Development (NED) perspective (defined above) rather than RED perspective.

Strategic Bias: A term used to describe potential biases in contingent-valuation results that would occur if study participants **intentionally** state untrue responses in order to influence study results in ways that they perceive to be advantageous to themselves. For example, suppose that white-water boaters believed that our study results would influence fees charged by the National Park Service. Suppose, further, that they answered our CV questions in ways that would lower our final results in order to minimize this effect. This would be a strategic bias in the value estimates. This term is used in contrast to hypothetical bias (defined above) where distortions are unintentional.

Surplus Value: In recreation economics, surplus value (also called consumer's surplus) is the maximum amount a person is willing to pay for access to the recreational resource over and above actual expenditures (defined above).

Total Value: As used in recreation economics, total value equals expenditures (as defined above) plus surplus value (as defined above).

Travel-Cost Method: A method of estimating the surplus value (defined above) of a recreational activity using data on trip-related expenditures (defined above) and number of trips taken.

Trip: In this study, one complete visit to Glen Canyon National Recreation Area and/or Grand Canyon National Park to engage in white-water boating, fishing, or day-use rafting. Except for day-use rafting, trips typically involve more than one recreation day, as defined above.

User Day (also Visitor Day of Recreation): Twelve hours of recreation of a given type. For example, two people fishing for six hours each would constitute one user day.

Willingness to Pay: An approach for estimating values, where value is defined as the maximum amount a consumer would be willing to pay for the outputs rather than do without them.

A-1

APPENDICES

GLEN CANYON DAM RELEASES AND DOWNSTREAM RECREATION: AN ANALYSIS OF USER PREFERENCES AND ECONOMIC VALUES

Recreation
of the
Glen Canyon Environmental Studies

By

Richard C. Bishop
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HBRS

GCES Report No.

January, 1987

A-ii

LIST OF APPENDICES

APPENDIX A

WHITE-WATER COMMERCIAL GUIDE SURVEY

There are many different alternatives for flow regimes from the Glen Canyon Dam. The purpose of this study is to find out how different flows affect river running in the Grand Canyon. As an experienced boatman, you are the expert and have detailed knowledge of the effects different flows have on river trips. Regardless of whether you have taken 1 trip or 100 trips in the Grand Canyon, your opinions are important. You can contribute your expertise to the decision-making process by filling out this questionnaire.

We're going to ask you about the effect of different water levels on the rapids, campsites, and attraction sites in the Grand Canyon, as well as your preferences for alternative flow regimes. Please answer the questions from your perspective as a commercial guide.

Please check below the kind of boat you **most often** use for your trips: (PLEASE CHOOSE **ONE** TYPE OF BOAT)

_____ MOTOR RAFT----------> _____ 33 feet or larger

_____ smaller than 33 feet

_____ ROWING RAFT---------> _____ 20 feet or larger

_____ less than 20 feet

_____ DORY

Please answer all the remaining questions BASED ON THE KIND OF BOAT YOU INDICATED ABOVE.

RAPIDS

In this first section, we are interested in learning how different water levels affect rapids.

---

1. Assuming you were to run an **ENTIRE GRAND CANYON TRIP AT A CONSTANT FLOW**, please specify the minimum and maximum water levels for running rapids safely with passengers, the level that provides the best ride, and the level you prefer, as a guide, for running rapids.

	(ANSWER IN CFS)
Minimum level for running safely with passengers	_______ cfs
Maximum level for running safely with passengers	_______ cfs
Best ride for passengers	_______ cfs
Water level you prefer as a guide	_______ cfs

2. Which rapids would be most problematic **BELOW** your minimum safety level? (IF NONE, WRITE NONE)

   1 ______________________________

   2 ______________________________

   3 ______________________________

3. Which rapids would be problematic **ABOVE** your maximum safety level? (IF NONE, WRITE NONE)

   1 ______________________________

   2 ______________________________

   3 ______________________________

CAMPSITES

There may be several areas in the Canyon where camps become a problem at certain water levels. For the items below, please identify the water levels where camps become a problem.

---

1. Would certain flow levels cause problems with access to or use of campsites for you?

   1 NO---->**Skip to next page, question 1**

   2 YES

PLEASE FILL IN EACH OF THE BLANKS BELOW IF APPLICABLE

2. Below ________cfs, we would have problems getting to camp on time because we would have to spend too much time traveling on the river.

3. Above ________cfs, important camps might be unavailable for use because they are under water.

4. With daily fluctuations of more than ________cfs, we would have problems with hanging up boats, loading boats, or having to move camp.

5. Which campsites would be most problematic at **low water** (9,000 cfs or less) with the type of boat you most often use? (IF NONE, WRITE NONE)

   1 ______________________________

   2 ______________________________

   3 ______________________________

6. Which campsites would be most problematic at **high water** (32,000 cfs or more) with the type of boat you most often use? (IF NONE, WRITE NONE)

   1 ______________________________

   2 ______________________________

   3 ______________________________

TIME FOR ATTRACTIONS

It may be that certain water levels allow more or less time for stops at attraction sites. For the following items, please indicate which flow levels, if any, would affect your stops at attraction sites.

---

1. Would certain flow levels cause problems with access to or use of attractions for your trip?

   1 NO---->**Skip to next page, question 1**

   2 YES

PLEASE FILL IN EACH OF THE BLANKS BELOW IF APPLICABLE

2. Below __________ cfs there would not be enough time for stops at attractions because of the need to "make up time"

3. From _________ to __________ cfs the amount of time for stops at attractions would be "about right"

4. Above _________ cfs there would be extra time for stops at attractions

5. Which attraction sites would be most problematic (difficult to pull in, tie up, or load and unload passengers) at **low water** (9,000 cfs or less)? (IF NONE, WRITE NONE)

   1 ____________________________

   2 ____________________________

   3 ____________________________

6. Which attraction sites would be most problematic (difficult to pull in, tie up, or load and unload passengers) at **high water** (32,000 cfs or above)? (IF NONE, WRITE NONE)

   1 ____________________________

   2 ____________________________

   3 ____________________________

CONSTANT FLOW LEVELS

1. How would you, as a commercial river guide using the boat you usually pilot, evaluate each of the following water levels for a commercial Grand Canyon river trip? Assume the water level would be constant for the entire trip. (CIRCLE ONE NUMBER FOR EACH WATER LEVEL)

Flow Level	Very Satisfactory	Somewhat Satisfactory	Neutral	Somewhat Unsatisfactory	Very Unsatisfactory
2,000 cfs	1	2	3	4	5
3,000 cfs	1	2	3	4	5
4,000 cfs	1	2	3	4	5
5,000 cfs	1	2	3	4	5
7,500 cfs	1	2	3	4	5
10,000 cfs	1	2	3	4	5
15,000 cfs	1	2	3	4	5
20,000 cfs	1	2	3	4	5
25,000 cfs	1	2	3	4	5
30,000 cfs	1	2	3	4	5
40,000 cfs	1	2	3	4	5
50,000 cfs	1	2	3	4	5
60,000 cfs	1	2	3	4	5
80,000 or more	1	2	3	4	5

In the following questions, we would like to know about tolerable daily fluctuations in flow.

---

1. Do you feel that you can accurately describe the daily water level fluctuations you have experienced in terms of cfs daily change?

   1 NO----->**Please skip to next page**

   2 YES

2. If the flow is somewhere in the range from 5,000 to 9,000 cfs, what is the largest daily change in flow that is tolerable?

   __________ cfs daily change

3. If the flow is somewhere in the range from 9,000 to 16,000 cfs, what is the largest daily change in flow that is tolerable?

   __________ cfs daily change

4. If the flow is somewhere in the range from 16,000 to 32,000 cfs, what is the largest daily change in flow that is tolerable?

   __________ cfs daily change

5. If the flow is somewhere above 32,000 cfs, what is the largest daily change in flow that is tolerable?

   __________ cfs daily change

ALTERNATIVE FLOW REGIMES

In this next section, we have listed 4 different scenarios for RELEASE PATTERNS FROM THE GLEN CANYON DAM. For each one, please check the disadvantages you perceive as a commercial river guide. After considering all four scenarios, please indicate which one you prefer most.

In these questions, we are interested only in factors related to your ability to conduct trips, not impacts on the geology or biology of the Canyon. These scenarios are for discussion only; they are not currently being proposed as actual operating procedures for the dam.

SCENARIO A: There would be no daily fluctuations, but flows would change from one month to the next. Flows during May, June, July, and August would be 10,000, 10,400, 12,750, and 14,400 cfs respectively, with no daily fluctuations. The rest of the year, flows would range from 8,300 cfs - 14,600 cfs, again with no daily fluctuations.

Possible problems (check those which apply to this scenario during May through August and from September through April)

May-Aug.	Sept.-Apr.	
______	______	too much time on river
______	______	not enough time for attraction sites
______	______	no flexibility in running trip
______	______	unable to avoid other people at attractions or camps
______	______	difficulty with mooring boats
______	______	problems running rapids
______	______	difficult to plan timing for attraction sites or camps
______	______	inadequate flow
______	______	not enough challenge/fun in rapids
______	______	lowest flows are too low
______	______	other (please specify)______________________________

Your **OVERALL** evaluation of this flow scenario (CIRCLE ONE):

completely acceptable   somewhat acceptable   neutral   somewhat unacceptable   completely unacceptable

SCENARIO B: Flows would be constant at 25,000 cfs during June, July, and August. During the rest of the year, **daily** flows could range from 1,000 to 31,500 cfs.

Possible problems (check those which apply to this scenario during June through August and from September through May)

June-Aug.	Sept.-May	
______	______	flow is too unpredictable
______	______	too much time on river
______	______	not enough time for attraction sites
______	______	no flexibility in running trip
______	______	unable to avoid other people at attractions or camps
______	______	difficulty with mooring boats
______	______	problems running rapids
______	______	difficult to plan timing for attraction sites or camps
______	______	inadequate flow
______	______	problems with fluctuations at camps (hanging-up boats, etc.)
______	______	not enough challenge/fun in rapids
______	______	lowest flows are too low
______	______	other (please specify)______________________________

Your **OVERALL** evaluation of this flow scenario (CIRCLE ONE):

completely acceptable	somewhat acceptable	neutral	somewhat unacceptable	completely unacceptable

SCENARIO C: Flows would vary by day, season, and month. During June, July, and August, daily flows could range from 3,000 to 31,500 cfs with a major peak at 3:00 p.m. During the rest of the year, daily flows could range from 1,000 to 31,500 cfs.

Possible problems (check those which apply to this scenario during June through August and from September through May)

June-Aug.	Sept.-May	
______	______	flow is too unpredictable
______	______	too much time on river
______	______	not enough time for attraction sites
______	______	no flexibility in running trip
______	______	unable to avoid other people at attractions or camps
______	______	difficulty with mooring boats
______	______	problems running rapids
______	______	difficult to plan timing for attraction sites or camps
______	______	inadequate flow
______	______	problems with fluctuations at camps (hanging-up boats, etc.)
______	______	not enough challenge/fun in rapids
______	______	lowest flows are too low
______	______	other (please specify)______________________________

Your **OVERALL** evaluation of this flow scenario (CIRCLE ONE):

completely acceptable	somewhat acceptable	neutral	somewhat unacceptable	completely unacceptable

SCENARIO D: Flows would vary by day, season, and month. Throughout the year, daily flows could range from 8,000 to 25,000 cfs. During the summer there would be a major peak around 3:00 p.m.

Possible problems (check those which apply to this scenario)

_____ flow is too unpredictable

_____ too much time on river

_____ not enough time for attraction sites

_____ no flexibility in running trip

_____ unable to avoid other people at attractions or camps

_____ difficulty with mooring boats

_____ problems running rapids

_____ difficult to plan timing for attraction sites or camps

_____ inadequate flow

_____ problems with fluctuations at camps (hanging-up boats, etc.)

_____ not enough challenge/fun in rapids

_____ lowest flows are too low

_____ other (please specify) ________________________________
____

Your **OVERALL** evaluation of this flow scenario (CIRCLE ONE):

completely acceptable	somewhat acceptable	neutral	somewhat unacceptable	completely unacceptable

---

OVERALL, how would you rank the four flow scenarios (A-D) presented above from your perspective as a commercial river guide? (PLEASE RANK EACH SCENARIO)

	Scenario Letter
Most preferred scenario	______
Next most preferred scenario	______
Third most preferred scenario	______
Least preferred scenario	______

GENERAL IMPACTS ON TRIP

1. At what **CONSTANT FLOW LEVELS** in the Grand Canyon have you had to do any of the following? Assume each water level is a constant flow for the entire trip. FOR EACH ITEM, PLEASE CHECK ALL WATER LEVELS THAT APPLY.

	--------Constant Flow Level (cfs x 1000)------							
	1-5	5-10	10-15	15-20	20-25	25-35	35-50	Over 50
Stop at major rapids such as Houserock, Hance, Crystal or Lava to scout	___	___	___	___	___	___	___	___
Stop at any other rapids to scout	___	___	___	___	___	___	___	___
Row or motor more than usual to make up some time	___	___	___	___	___	___	___	___
Row less than usual or turn off motor because you are ahead of schedule	___	___	___	___	___	___	___	___
Hurry to get out of camp in the morning	___	___	___	___	___	___	___	___
Have passengers walk around a rapid because the water is too low	___	___	___	___	___	___	___	___
Have passengers walk around a rapid because the water is too high	___	___	___	___	___	___	___	___
Other____________________ ______________________	___	___	___	___	___	___	___	___

2. Assume that flow levels were varying from a low of 3,000 cfs to a high of 25,000 cfs each day (or within a 24 hour period). UNDER THESE FLOW CONDITIONS, which of the following would you be likely to do? (PLEASE CIRCLE ONE NUMBER FOR EACH ITEM)

	Very Likely	Somewhat Likely	Not at all Likely
Stop to scout rapids more often than usual	1	2	3
Select specific campsites because they offer better protection against water level changes	1	2	3
Camp above a major rapid to wait for the water level to change	1	2	3
Change your itinerary to try to reach certain points at a good time	1	2	3
Check on the boat mooring during the evening to see if it should be moved	1	2	3
Spend <u>more</u> time at scheduled attraction stops	1	2	3
Spend <u>less</u> time at scheduled attraction stops	1	2	3
Spend less time in camp	1	2	3
Make camp earlier	1	2	3

EXTRA TIME ON YOUR TRIP

1. If your commercial trip was making good time and 6-8 fewer hours of actual river time was needed to complete the trip in the scheduled time, which of the following would you be most likely to do? (CIRCLE ONE NUMBER FOR EACH ITEM)

	Not at all Likely	Somewhat Likely	Very Likely
Turn motor off and float	1	2	3
Stay in camp later in the morning	1	2	3
Make camp earlier in the afternoon	1	2	3
Take longer lunches	1	2	3
Spend more time scouting rapids	1	2	3
Spend more time at scheduled attraction stops	1	2	3
Stop at additional attraction sites	1	2	3
Spend a layover day at a campsite	1	2	3

2. If your commercial trip was making good time and you decided to stop at ADDITIONAL attraction sites (sites you don't usually visit), what are the <u>three</u> additional attraction sites you would most likely stop?

(FOR EACH ATTRACTION SITE, ALSO INDICATE WHAT YOU WOULD SUGGEST THAT PASSENGERS DO. PLEASE TRY TO BE SPECIFIC--IF YOU WOULD SUGGEST A HIKE, INDICATE WHERE (PLACE NAME) YOU WOULD RECOMMEND THAT THEY HIKE).

ATTRACTION SITE ______________________ **River Mile** ____________

What would you suggest that passengers do here?

____

____

____

ATTRACTION SITE ______________________ **River Mile** ____________

What would you suggest that passengers do here?

____

____

____

ATTRACTION SITE ______________________ **River Mile** ____________

What would you suggest that passengers do here?

____

____

____

3. If your commercial trip was making good time and you decided to spend an EXTRA layover day somewhere, what are the three campsites at which you would be most likely to layover for a day.

(FOR EACH CAMPSITE, ALSO INDICATE WHAT YOU WOULD SUGGEST THAT PASSENGERS DO. PLEASE TRY TO BE SPECIFIC--IF YOU WOULD SUGGEST A DAY HIKE, INDICATE WHERE (PLACE NAME) YOU WOULD RECOMMEND THAT THEY HIKE).

CAMPSITE ______________________ **River Mile** ____________

What would you suggest that passengers do here on a layover day?

____

____

____

CAMPSITE ______________________ **River Mile** ____________

What would you suggest that passengers do here on a layover day?

____

____

____

CAMPSITE ______________________ **River Mile** ____________

What would you suggest that passengers do here on a layover day?

____

____

____

INFORMATION ON FLOW RELEASES

1. In the past, have you used information concerning scheduled Glen Canyon Dam releases as a basis for making decisions about your raft trips in the Grand Canyon (e.g. when to run particular rapids, when to camp, where to moor boats, etc.)? (CIRCLE ONE NUMBER)

   1 NO---->**Skip to next page, question 5**

   2 YES

2. What has been your **MOST** common means of obtaining this information?

   ____

3. How reliable have you found this information about scheduled releases to be? (CIRCLE ONE NUMBER)

   1 Always accurate

   2 Usually accurate

   3 So-so

   4 Seldom accurate

   5 Never accurate

4. How useful have you found this information about scheduled releases to be? (CIRCLE ONE NUMBER)

   1 I always based trip decisions on the information I received about scheduled release patterns

   2 Most of my trip decisions were based on the information I received about scheduled release patterns

   3 In making trip decisions I relied on my own observation of river conditions as much as information I received about scheduled release patterns

   4 Most of my trip decisions were based on my own observation of river conditions

   5 All of my trip decisions were based on my own observation of river conditions

5. Prior to 1983, water was released from the Glen Canyon Dam in a fairly regular pattern. This pattern often resulted in daily fluctuations of 20,000 cfs. During the summer, the highest flow releases occurred in the late afternoon or early evening, and average weekend flow releases were less than average weekday flows.

Would a regular pattern of releases make it easier to conduct a commercial white water raft trip in the Grand Canyon? (CIRCLE ONE NUMBER)

1 DEFINITELY NOT

2 PROBABLY NOT

3 PROBABLY YES

4 DEFINITELY YES

6. Do you have any suggestions on how to improve the ways that water release patterns and general river information are communicated to river runners?

____

____

____

____

____

RELATIONSHIP BETWEEN FLOW LEVELS AND ACCIDENTS ON THE RIVER

1. Which of the following factors, in your opinion, are the most important causes of rafting accidents on the Colorado river? (PLEASE RANK EACH FACTOR FROM 1 TO 7, RANKING THE MOST IMPORTANT FACTOR AS 1)

   ___ EQUIPMENT FAILURE

   ___ VERY HIGH WATER (ABOVE 45,000 CFS)

   ___ VERY LOW WATER (BELOW 5,000 CFS)

   ___ DAILY FLUCTUATIONS IN WATER LEVEL

   ___ BOATMAN INEXPERIENCE

   ___ BOATMAN ERROR

   ___ WEATHER

2. Are there any other factors that should be added to the above list?

   ____

   ____

   ____

3. Given your experience as a commercial guide, do you feel that accidents on the Colorado river such as losing equipment, damaging a boat, or passengers falling out of a boat are more likely to happen under certain flow levels than at others?

   1 NO, I think most water accidents happen INDEPENDENTLY of flow level

   2 YES, I think water accidents are more likely to happen at the following flow levels (CIRCLE ALL THAT APPLY):

      1 flows less than 5,000 cfs

      2 5,000 - 8,999 cfs

      3 9,000 - 15,999 cfs

      4 16,000 - 31,999 cfs

      5 32,000 - 45,000 cfs

      6 above 45,000 cfs

4. Do you feel that more **SEVERE** accidents (such as flipping a boat or serious injuries to passengers) are more likely to happen under certain flow levels than at others?

   1 NO, I think the **severity** of the accidents is not related to flow level

   2 YES, I think more **severe** accidents are likely to happen at the following flow levels (CIRCLE ALL THAT APPLY):

      1 Flows less than 5,000 cfs
      If so, where? ______________________

      2 5,000 - 8,999 cfs
      If so, where? ______________________

      3 9,000 - 15,999 cfs
      If so, where? ______________________

      4 16,000 - 31,999 cfs
      If so, where? ______________________

      5 32,000 - 45,000 cfs
      If so, where? ______________________

      6 Above 45,000 cfs
      If so, where? ______________________

In this last section we would like to ask some questions about your background which will help us compare your answers to those of other guides.

---

1. How old are you? _____years old

2. How many years have you been a commercial guide in the Grand Canyon?

   ______years

3. For how many of these years was the **majority** of your time spent guiding oar or motor trips?

   _______ years on oar trips

   _______ years on motor trips

4. About how many trips in Grand Canyon have you taken as a commercial guide with each of the following types of boat? (IF NONE FOR A PARTICULAR TYPE OF BOAT, WRITE IN 0)

   ______ trips on motorized rafts

   ______ trips on rowing rafts

   ______ trips on dories

5. What kind of commercial trips did you run in 1985? (CIRCLE ALL THAT APPLY)

   1 MOTORIZED RAFT

   2 ROWING RAFT

   3 DORY

6. In 1985, how many days did your trips usually take? ______ days

7. At which flow levels have you run commercial Grand Canyon river trips? (COMPLETE ALL THAT APPLY)

   Lowest flow level: ___________ cfs

   Highest flow level: ___________ cfs

   Largest daily change in flow level: __________ cfs

If you would like a summary of the questionnaire results, please check here: _____

THANK YOU FOR YOUR HELP!

APPENDIX B

WHITE-WATER PRIVATE TRIP LEADER SURVEY

There are many different alternatives for flow regimes from the Glen Canyon Dam. The purpose of this study is to find out how different flows affect river running in the Grand Canyon. As an experienced boatman, you are the expert and have detailed knowledge of the effects different flows have on river trips. Regardless of whether you have taken 1 trip or 100 trips in the Grand Canyon, your opinions are important. You can contribute your expertise to the decision-making process by filling out this questionnaire.

We're going to ask you about the effect of different water levels on the rapids, campsites, and attraction sites, as well as your preferences for flow regimes in the Grand Canyon. Please answer the questions from your perspective as an experienced boater and trip leader.

Please check below the kind of boat you **most often** use for your trips: (PLEASE CHOOSE ONE TYPE OF BOAT)

_____ MOTOR RAFT----------> _____ 33 feet or larger

_____ smaller than 33 feet

_____ ROWING RAFT---------> _____ 20 feet or larger

_____ less than 20 feet

_____ DORY

_____ OTHER (please specify ________________________________)

Please answer all the remaining questions BASED ON THE KIND OF BOAT YOU INDICATED ABOVE.

RAPIDS

In this first section, we are interested in learning how different water levels affect rapids.

1. Assuming you were to run an **ENTIRE GRAND CANYON TRIP AT A CONSTANT FLOW**, please specify the minimum and maximum water levels for running rapids safely with a group, the level that provides the best ride, and the level you prefer as a trip leader for running rapids.

	(ANSWER IN CFS)
Minimum level for running safely with a group	_______ cfs
Maximum level for running safely with a group	_______ cfs
Best ride for trip members	_______ cfs
Water level you prefer as a trip leader	_______ cfs

2. Which rapids would be most problematic **BELOW** your minimum safety level? (IF NONE, PLEASE WRITE NONE)

   1 ____________________________
   2 ____________________________
   3 ____________________________

3. Which rapids would be problematic **ABOVE** your maximum safety level? (IF NONE, PLEASE WRITE NONE)

   1 ____________________________
   2 ____________________________
   3 ____________________________

CAMPSITES

There may be several areas in the Canyon where camps become a problem at certain water levels. For the items below, please identify the water levels where camps become a problem.

---

1. Would certain flow levels cause problems with access to or use of campsites for you? (CIRCLE ONE)

   1 NO---->**Skip to next page, question 1**

   2 YES

PLEASE FILL IN EACH OF THE BLANKS BELOW IF APPLICABLE

2. Below ______ cfs, we would have problems getting to camp on time because we would have to spend too much time traveling on the river.

3. Above ______ cfs, important camps might be unavailable for use because they are under water.

4. With daily fluctuations of more than ______ cfs, we would have problems with hanging up boats, loading boats, or having to move camp.

5. Which campsites would be most problematic at **low water** (9,000 cfs or less) with the type of boat you most often use? (IF NONE, WRITE NONE)

   1 ______________________________
   2 ______________________________
   3 ______________________________

6. Which campsites would be most problematic at **high water** (32,000 cfs or more) with the type of boat you most often use? (IF NONE, WRITE NONE)

   1 ______________________________
   2 ______________________________
   3 ______________________________

TIME FOR ATTRACTIONS

It may be that certain water levels allow more or less time for stops at attraction sites. For the following items, please indicate which flow levels, if any, would affect your stops at attraction sites.

---

1. Would certain flow levels cause problems with access to or use of attractions for your trip?

   1 NO---->**Skip to next page, question 1**

   2 YES

PLEASE FILL IN EACH OF THE BLANKS BELOW IF APPLICABLE

2. Below _________ cfs there would not be enough time for stops at attractions because of the need to "make up time"

3. From _________ to _________ cfs the amount of time for stops at attractions would be "about right"

4. Above _________ cfs there would be extra time for stops at attractions

5. Which attraction sites would be most problematic (difficult to pull in, tie up, or load and unload trip members) at **low water** (9,000 cfs or less)? (IF NONE, WRITE NONE)

   1 ______________________________

   2 ______________________________

   3 ______________________________

6. Which attraction sites would be most problematic (difficult to pull in, tie up, or load and unload trip members) at **high water** (32,000 cfs or above)? (IF NONE, WRITE NONE)

   1 ______________________________

   2 ______________________________

   3 ______________________________

CONSTANT FLOW LEVELS

1. How would you, as a private trip leader using the boat you usually pilot, evaluate each of the following water levels for a private Grand Canyon river trip? Assume the water level is constant for the entire trip. (CIRCLE ONE NUMBER FOR EACH WATER LEVEL)

Flow Level	Very Satisfactory	Somewhat Satisfactory	Neutral	Somewhat Unsatisfactory	Very Unsatisfactory
2,000 cfs	1	2	3	4	5
3,000 cfs	1	2	3	4	5
4,000 cfs	1	2	3	4	5
5,000 cfs	1	2	3	4	5
7,500 cfs	1	2	3	4	5
10,000 cfs	1	2	3	4	5
15,000 cfs	1	2	3	4	5
20,000 cfs	1	2	3	4	5
25,000 cfs	1	2	3	4	5
30,000 cfs	1	2	3	4	5
40,000 cfs	1	2	3	4	5
50,000 cfs	1	2	3	4	5
60,000 cfs	1	2	3	4	5
80,000 or more	1	2	3	4	5

In the following questions, we would like to know about tolerable daily fluctuations in flow.

---

1. Do you feel that you can accurately describe the daily water level fluctuations you have experienced in terms of <u>cfs daily change</u>?

   1 NO----->**Please skip to next page**

   2 YES

2. If the flow is somewhere in the range from 5,000 to 9,000 cfs, what is the largest daily change in flow that is tolerable?

   __________ cfs daily change

3. If the flow is somewhere in the range from 9,000 to 16,000 cfs, what is the largest daily change in flow that is tolerable?

   __________ cfs daily change

4. If the flow is somewhere in the range from 16,000 to 32,000 cfs, what is the largest daily change in flow that is tolerable?

   __________ cfs daily change

5. If the flow is somewhere above 32,000 cfs, what is the largest daily change in flow that is tolerable?

   __________ cfs daily change

ALTERNATIVE FLOW REGIMES

In this next section, we have listed 4 different scenarios for RELEASE PATTERNS FROM THE GLEN CANYON DAM. For each one, please check the disadvantages you perceive as a private trip leader. After considering all four scenarios, please indicate which one you prefer most.

In these questions, we are interested only in factors related to your ability to conduct trips, not impacts on the geology or biology of the Canyon. These scenarios are for discussion only; they are not currently being proposed as actual operating procedures for the dam.

SCENARIO A: There would be no daily fluctuations, but flows would change from one month to the next. Flows during May, June, July, and August would be 10,000, 10,400, 12,750, and 14,400 cfs respectively, with no daily fluctuations. The rest of the year, flows would range from 8,300 cfs - 14,600 cfs, again with no daily fluctuations.

Possible problems (check those which apply to this scenario during May through August and from September through April)

May-Aug.	Sept.-Apr.	
______	______	too much time on river
______	______	not enough time for attraction sites
______	______	no flexibility in running trip
______	______	unable to avoid other people at attractions or camps
______	______	difficulty with mooring boats
______	______	problems running rapids
______	______	difficult to plan timing for attraction sites or camps
______	______	inadequate flow
______	______	not enough challenge/fun in rapids
______	______	lowest flows are too low
______	______	other (please specify)______________________________

Your **OVERALL** evaluation of this flow scenario (CIRCLE ONE):

completely acceptable	somewhat acceptable	neutral	somewhat unacceptable	completely unacceptable

SCENARIO B: Flows would be constant at 25,000 cfs during June, July, and August. During the rest of the year, **daily** flows could range from 1,000 to 31,500 cfs.

Possible problems (check those which apply to this scenario during June through August and from September through May)

June-Aug.	Sept.-May	
______	______	flow is too unpredictable
______	______	too much time on river
______	______	not enough time for attraction sites
______	______	no flexibility in running trip
______	______	unable to avoid other people at attractions or camps
______	______	difficulty with mooring boats
______	______	problems running rapids
______	______	difficult to plan timing for attraction sites or camps
______	______	inadequate flow
______	______	problems with fluctuations at camps (hanging-up boats, etc.)
______	______	not enough challenge/fun in rapids
______	______	lowest flows are too low
______	______	other (please specify)________________________________

Your **OVERALL** evaluation of this flow scenario (CIRCLE ONE):

completely acceptable	somewhat acceptable	neutral	somewhat unacceptable	completely unacceptable

SCENARIO C: Flows would vary by day, season, and month. During June, July, and August, daily flows could range from 3,000 to 31,500 cfs with a major peak at 3:00 p.m. During the rest of the year, daily flows could range from 1,000 to 31,500 cfs.

Possible problems (check those which apply to this scenario during June through August and from September through May)

June-Aug.	Sept.-May	
______	______	flow is too unpredictable
______	______	too much time on river
______	______	not enough time for attraction sites
______	______	no flexibility in running trip
______	______	unable to avoid other people at attractions or camps
______	______	difficulty with mooring boats
______	______	problems running rapids
______	______	difficult to plan timing for attraction sites or camps
______	______	inadequate flow
______	______	problems with fluctuations at camps (hanging-up boats, etc.)
______	______	not enough challenge/fun in rapids
______	______	lowest flows are too low
______	______	other (please specify)______________________________

Your **OVERALL** evaluation of this flow scenario (CIRCLE ONE):

completely acceptable	somewhat acceptable	neutral	somewhat unacceptable	completely unacceptable

SCENARIO C: Flows would vary by day, season, and month. During June, July, and August, daily flows could range from 3,000 to 31,500 cfs with a major peak at 3:00 p.m. During the rest of the year, daily flows could range from 1,000 to 31,500 cfs.

Possible problems (check those which apply to this scenario during June through August and from September through May)

June-Aug.	Sept.-May	
______	______	flow is too unpredictable
______	______	too much time on river
______	______	not enough time for attraction sites
______	______	no flexibility in running trip
______	______	unable to avoid other people at attractions or camps
______	______	difficulty with mooring boats
______	______	problems running rapids
______	______	difficult to plan timing for attraction sites or camps
______	______	inadequate flow
______	______	problems with fluctuations at camps (hanging-up boats, etc.)
______	______	not enough challenge/fun in rapids
______	______	lowest flows are too low
______	______	other (please specify)______________________________

Your **OVERALL** evaluation of this flow scenario (CIRCLE ONE):

completely acceptable	somewhat acceptable	neutral	somewhat unacceptable	completely unacceptable

SCENARIO D: Flows would vary by day, season, and month. Throughout the year, daily flows could range from 8,000 to 25,000 cfs. During the summer there would be a major peak around 3:00 p.m.

Possible problems (check those which apply to this scenario)

_____ flow is too unpredictable
_____ too much time on river
_____ not enough time for attraction sites
_____ no flexibility in running trip
_____ unable to avoid other people at attractions or camps
_____ difficulty with mooring boats
_____ problems running rapids
_____ difficult to plan timing for attraction sites or camps
_____ inadequate flow
_____ problems with fluctuations at camps (hanging-up boats, etc.)
_____ not enough challenge/fun in rapids
_____ lowest flows are too low
_____ other (please specify) ________________________________
____

Your **OVERALL** evaluation of this flow scenario (CIRCLE ONE):

completely acceptable	somewhat acceptable	neutral	somewhat unacceptable	completely unacceptable

1. **OVERALL**, how would you rank these four flow scenarios (A-D) from your perspective as a river guide? (PLEASE RANK EACH SCENARIO)

	Scenario Letter
Most preferred scenario	______
Next most preferred scenario	______
Third most preferred scenario	______
Least preferred scenario	______

2. Imagine that you have a private permit for next year and you could choose one of the four water flow scenarios as well as the date for the trip. What water flow scenario and what month would you choose?

   Scenario letter ______

   Month ________________

GENERAL IMPACTS ON TRIP

1. As a private trip leader, have you experienced constant flow levels during any of your Grand Canyon trips?

    1 NO---->**Skip to next page, Question 3**

    2 YES

2. At what **CONSTANT FLOW LEVELS** in the Grand Canyon have you had to do any of the following? Assume each water level is a constant flow for the entire trip. FOR EACH ITEM, PLEASE CHECK ALL WATER LEVELS THAT APPLY.

	---------Constant Flow Level (cfs x 1000)------							
	1-5	5-10	10-15	15-20	20-25	25-35	35-50	Over 50
Stop at major rapids such as Houserock, Hance, Crystal or Lava to scout	___	___	___	___	___	___	___	___
Stop at any other rapids to scout	___	___	___	___	___	___	___	___
Row or motor more than usual to make up some time	___	___	___	___	___	___	___	___
Row less than usual or turn off motor because you are ahead of schedule	___	___	___	___	___	___	___	___
Hurry to get out of camp in the morning	___	___	___	___	___	___	___	___
Have trip members walk around a rapid because the water is too low	___	___	___	___	___	___	___	___
Have trip members walk around a rapid because the water is too high	___	___	___	___	___	___	___	___
Other____________________ ________________________	___	___	___	___	___	___	___	___

3. As a private boater, have you experienced daily fluctuating flow levels during any of your Grand Canyon trips?

   1 NO---->**Skip to next page, Question 1**

   2 YES

4. Assume that flow levels were varying from a low of 3,000 cfs to a high of 25,000 cfs each day (or within a 24 hour period). UNDER THESE FLOW CONDITIONS, which of the following would you be likely to do? (PLEASE CIRCLE ONE NUMBER FOR EACH ITEM)

	Very Likely	Somewhat Likely	Not at all Likely
Stop to scout rapids more often than usual	1	2	3
Select specific campsites because they offer better protection against water level changes	1	2	3
Camp above a major rapid to wait for the water level to change	1	2	3
Change your itinerary to try to reach certain points at a good time	1	2	3
Check on the boat mooring during the evening to see if it should be moved	1	2	3
Spend more time at scheduled attraction stops	1	2	3
Spend less time at scheduled attraction stops	1	2	3
Spend less time in camp	1	2	3
Make camp earlier	1	2	3

EXTRA TIME ON YOUR TRIP

1. If your trip was making good time and 6-8 fewer hours of actual river time was needed to complete the trip in the scheduled time, which of the following would you be most likely to do? (CIRCLE ONE NUMBER FOR EACH ITEM)

	Not at all Likely	Somewhat Likely	Very Likely
Stay in camp later in the morning	1	2	3
Make camp earlier in the afternoon	1	2	3
Take longer lunches	1	2	3
Spend more time scouting rapids	1	2	3
Spend more time at scheduled attraction stops	1	2	3
Stop at additional attraction sites	1	2	3
Spend a layover day at a campsite	1	2	3

2. If your trip was making good time and you decided to stop at ADDITIONAL attraction sites (sites you don't usually visit), what are the <u>three</u> additional attraction sites you would most likely stop?

(FOR EACH ATTRACTION SITE, ALSO INDICATE WHAT YOU WOULD SUGGEST THAT TRIP MEMBERS DO. PLEASE TRY TO BE SPECIFIC--IF YOU WOULD SUGGEST A HIKE, INDICATE WHERE (PLACE NAME) YOU WOULD RECOMMEND THAT THEY HIKE).

ATTRACTION SITE ______________________ **River Mile** ____________

What would you suggest that trip members do here?

____

____

____

ATTRACTION SITE ______________________ **River Mile** ____________

What would you suggest that trip members do here?

____

____

____

ATTRACTION SITE ______________________ **River Mile** ____________

What would you suggest that trip members do here?

____

____

____

3. If your trip was making good time and you decided to spend an EXTRA layover day somewhere, what are the <u>three</u> campsites at which you would be most likely to layover for a day.

(FOR EACH CAMPSITE, ALSO INDICATE WHAT YOU WOULD SUGGEST THAT TRIP MEMBERS DO. PLEASE TRY TO BE SPECIFIC--IF YOU WOULD SUGGEST A DAY HIKE, INDICATE WHERE (PLACE NAME) YOU WOULD RECOMMEND THAT THEY HIKE).

CAMPSITE ______________________ **River Mile** ____________

What would you suggest that trip members do here on a layover day?

____

____

____

CAMPSITE ______________________ **River Mile** ____________

What would you suggest that trip members do here on a layover day?

____

____

____

CAMPSITE ______________________ **River Mile** ____________

What would you suggest that trip members do here on a layover day?

____

____

____

INFORMATION ON FLOW RELEASES

1. In the past, have you used information concerning scheduled Glen Canyon Dam releases as a basis for making decisions about your raft trips in the Grand Canyon(e.g. when to run particular rapids, when to camp, where to moor boats, etc.)? (CIRCLE ONE NUMBER)

   1 NO---->**Skip to next page, question 5**

   2 YES

2. What has been your **MOST** common means of obtaining this information?

   ____

3. How reliable have you found this information about scheduled releases to be? (CIRCLE ONE NUMBER)

   1 Always accurate

   2 Usually accurate

   3 So-so

   4 Seldom accurate

   5 Never accurate

4. How useful have you found this information about scheduled releases to be over? (CIRCLE ONE NUMBER)

   1 I always based trip decisions on the information I received about scheduled release patterns

   2 Most of my trip decisions were based on the information I received about scheduled release patterns

   3 In making trip decisions I relied on my own observation of river conditions as much as information I received about scheduled release patterns

   4 Most of my trip decisions were based on my own observation of river conditions

   5 All of my trip decisions were based on my own observation of river conditions

5. Prior to 1983, water was released from the Glen Canyon Dam in a fairly regular pattern. This pattern often resulted in daily fluctuations of 20,000 cfs. During the summer, the highest flow releases occurred in the late afternoon or early evening, and average weekend flow releases were less than average weekday flows.

Would a regular pattern of releases make it easier to conduct a private white water raft trip in the Grand Canyon? (CIRCLE ONE NUMBER)

1 DEFINITELY NOT

2 PROBABLY NOT

3 PROBABLY YES

4 DEFINITELY YES

6. Do you have any suggestions on how to improve the ways that water release patterns and general river information are communicated to river runners?

____

____

____

____

____

RELATIONSHIP BETWEEN FLOW LEVELS AND ACCIDENTS ON THE RIVER

1. Which of the following factors, in your opinion, are the most important causes of rafting accidents on the Colorado river? (PLEASE RANK EACH FACTOR FROM 1 TO 7, RANKING THE MOST IMPORTANT FACTOR AS 1)

    ___ EQUIPMENT FAILURE

    ___ VERY HIGH WATER (ABOVE 45,000 CFS)

    ___ VERY LOW WATER (BELOW 5,000 CFS)

    ___ DAILY FLUCTUATIONS IN WATER LEVEL

    ___ BOATMAN INEXPERIENCE

    ___ BOATMAN ERROR

    ___ WEATHER

2. Are there any other factors that should be added to the above list?

    ____

    ____

    ____

3. Given your experience as a boater, do you feel that accidents on the Colorado river, such as losing equipment, damaging a boat, or people falling out of a boat are more likely to happen under certain flow levels than at others?

    1 NO, I think most water accidents happen INDEPENDENTLY of flow level

    2 YES, I think water accidents are more likely to happen at the following flow levels (CIRCLE ALL THAT APPLY):

        1 Flows less than 5,000 cfs

        2 5,000 - 8,999 cfs

        3 9,000 - 15,999 cfs

        4 16,000 - 31,999 cfs

        5 32,000 - 45,000 cfs

        6 Above 45,000 cfs

4. Do you feel that more **SEVERE** accidents (such as flipping a boat or serious injuries to trip members) are more likely to happen under certain flow levels than at others?

   1 NO, I think the **severity** of the accidents is not related to flow level

   2 YES, I think more **severe** accidents are likely to happen at the following flow levels (CIRCLE ALL THAT APPLY):

      1 Flows less than 5,000 cfs
      If so, where? ______________________________

      2 5,000 - 8,999 cfs
      If so, where? ______________________________

      3 9,000 - 15,999 cfs
      If so, where? ______________________________

      4 16,000 - 31,999 cfs
      If so, where? ______________________________

      5 32,000 - 45,000 cfs
      If so, where? ______________________________

      6 Above 45,000 cfs
      If so, where? ______________________________

In this final section we would like to ask some questions about your background which will help us compare your answers to those of other guides.

---

1. How old are you? _____ years old

2. How many years of white water boating trip leader experience have you had?

   ______years

3. About how many Grand Canyon river trips have you taken as a passenger or trip leader with each of the following types of boat? (IF NONE FOR A PARTICULAR TYPE OF BOAT, WRITE IN 0)

______ trips on motorized rafts

______ trips on rowing rafts

______ trips on dories

4. At which flow levels have you run Grand Canyon river trips? (COMPLETE ALL THAT APPLY)

Lowest flow level: __________ cfs

Highest flow level: __________ cfs

Largest daily change in flow level: _________ cfs

If you would like a summary of the questionnaire results, please check here: _____

THANK YOU FOR YOUR HELP!

APPENDIX C

WHITE-WATER BOATERS ATTRIBUTE SURVEY

In this first section, we are interested in finding out about your white water raft trip in the Grand Canyon and how much you enjoyed it.

1. Overall, how would you rate your raft trip? (CIRCLE ONE NUMBER)

   1 POOR

   2 FAIR, it just didn't work out very well

   3 GOOD, but a number of things could have been different

   4 VERY GOOD, but could have been better

   5 EXCELLENT, only minor problems

   6 PERFECT

2. What things would contribute most to an excellent or perfect raft trip in the Grand Canyon for you?

   ____

   ____

   ____

3. What things would contribute most to a poor raft trip in the Grand Canyon for you?

   ____

   ____

   ____

4. When you first decided to take a Grand Canyon trip, what was the **ONE** thing you looked forward to most?

   ____

5. Where did you put-in (start trip)? (CIRCLE ONE NUMBER)

    1 LEE'S FERRY
    2 PHANTOM RANCH
    3 OTHER (specify ________________________________)

6. Where did you take-out (end trip)? (CIRCLE ONE NUMBER)

    1 PHANTOM RANCH
    2 WHITMORE WASH
    3 DIAMOND CREEK
    4 LAKE MEAD
    5 OTHER (specify ________________________________)

7. How long was your trip? ________ DAYS

8. Including yourself, about how many people were there on this raft trip? (PLEASE INCLUDE THE GUIDE/TRIP LEADER AND ALL OF THE BOATS IN YOUR GROUP)

    _________PEOPLE

9. What type of boat were you on? (CIRCLE ONE NUMBER)

    1 MOTOR POWERED RAFT
    2 OAR POWERED RAFT
    3 COMBINATION MOTOR/OAR RAFT
    4 DORY
    5 KAYAK/CANOE
    6 PADDLE RAFT
    7 OTHER (specify ________________________________)

10. Was your Grand Canyon raft trip: (CHOOSE ONE)

    1 RUN BY A COMMERCIAL OUTFITTER

    2 A PRIVATE TRIP---->Were you primarily responsible for operating a boat on this trip?

        1 YES

        2 NO

11. Including this trip, how many times have you rafted the Colorado River below Lee's Ferry?

    ________TIMES

12. Besides your Grand Canyon trip(s), how many white water raft or kayak trips have you taken at other locations? (CIRCLE ONE NUMBER)

    1 NONE

    2 1-2

    3 3-5

    4 6-10

    5 11-20

    6 MORE THAN 20

13. If you had the opportunity, would you take a Grand Canyon white water raft trip again? (CIRCLE ONE NUMBER)

    1 DEFINITELY NOT

    2 PROBABLY NOT

    3 PROBABLY YES

    4 DEFINITELY YES

14. River trips through the Grand Canyon have a number of features. People differ in what they feel is important for them personally. In this next section, we list a number of features of a Grand Canyon river trip. Please indicate how important each feature was for you on your trip. (CIRCLE ONE NUMBER FOR EACH ITEM)

	Not at all Important	Somewhat Important	Very Important	Didn't Experience
Observing flora, fauna, and geology	1	2	3	0
Being in a natural setting	1	2	3	0
Being on the Colorado River	1	2	3	0
Being with family/friends	1	2	3	0
Relaxing; getting away from it all	1	2	3	0
Camping on sandy beaches	1	2	3	0
Large rapids	1	2	3	0
Stopping at side canyons or creeks	1	2	3	0
Learning about the history of the Grand Canyon	1	2	3	0
Photographing the Grand Canyon	1	2	3	0
Seeing few other people while floating	1	2	3	0
Hiking in the side canyons	1	2	3	0
Floating on quiet stretches of the river	1	2	3	0
Seeing wildlife	1	2	3	0
Interacting with my guide or trip leader	1	2	3	0
Visiting archeological sites	1	2	3	0

	Not at all Important	Somewhat Important	Very Important	Didn't Experience
Sense of accomplishment of making it through the trip	1	2	3	0
Feeling safe	1	2	3	0
Confidence in my guide or trip leader	1	2	3	0
Good weather	1	2	3	0
Good food	1	2	3	0
Interacting with others on my trip	1	2	3	0
Seeing few other people at beaches or attraction sites	1	2	3	0
Fishing in the Grand Canyon	1	2	3	0

Did we miss anything else that was important?____________________

____

15. On average, how crowded did you feel the river was while you were floating? (Circle the number on the scale best representing your feelings.)

1	2	3	4	5	6	7	8	9
not at all crowded		slightly crowded		moderately crowded			extremely crowded	

16. On your trip, did you feel you had enough time to hike the side canyons and see other attractions? (CIRCLE ONE NUMBER)

    1 YES, THERE WAS ENOUGH TIME FOR HIKING

    2 NO, THERE WAS NOT ENOUGH TIME FOR HIKING

    3 THERE WAS TOO MUCH TIME FOR HIKING

Rapids are an important part of the Grand Canyon trip for some people. In this next section, we would like to get your expectations and feelings about the rapids.

---

1. What role did rapids play in your decision to take this trip? (CIRCLE ONE NUMBER)

   1 RAPIDS WERE THE MOST IMPORTANT REASON FOR TAKING THE TRIP

   2 RAPIDS WERE ONE OF THE TWO OR THREE MOST IMPORTANT REASONS FOR TAKING THE TRIP

   3 RAPIDS WERE ONLY ONE OF MANY IMPORTANT REASONS FOR TAKING THE TRIP

   4 RAPIDS WERE NOT AN IMPORTANT REASON FOR TAKING THE TRIP

2. Would you say the rapids you encountered on your trip were: (CIRCLE ONE NUMBER)

   1 SMALLER THAN YOU EXPECTED

   2 BIGGER THAN YOU EXPECTED

   3 ABOUT WHAT YOU EXPECTED----->Skip to Question 4

   4 HAD NO EXPECTATIONS--------->Skip to Question 4

3. If the rapids were smaller or bigger than you expected, how did you feel about it? (CIRCLE ONE NUMBER)

   1 LIKED IT

   2 DIDN'T MAKE ANY DIFFERENCE

   3 DIDN'T LIKE IT

4. On this trip, did you have to wait above any rapid before running it?

   1 NO

   2 YES---->Did you have to wait for: (CIRCLE ALL THAT APPLY)

      1 OTHER BOATS TO GO THROUGH

      2 WATER LEVEL TO CHANGE

      3 OTHER ______________________________

5. Did you have to walk around any rapids?

   1 NO

   2 YES---->Which rapids?________________________________

6. In general, which type of rapid did you enjoy most on this trip: (CHOOSE ONE)

   1 BIG RAPIDS

   2 MEDIUM RAPIDS

   3 SMALL RAPIDS

   4 LIKED ALL TYPES OF RAPIDS EQUALLY

   5 DON'T LIKE RAPIDS AT ALL---->Skip to Question 8

7. What is the **ONE** thing you liked most about the rapids on this Grand Canyon trip? (PLEASE TRY TO BE SPECIFIC)

____

8. For each of the following rapids, please indicate how you felt about that particular rapid. If you didn't run it or don't remember it, circle the number "0". (SEE THE ENCLOSED MAP OF THESE RAPIDS)

Name of Rapid	Strongly Disliked	Somewhat Disliked	Neutral	Somewhat Liked	Strongly Like	Don't Remember or Didn't Run
House Rock Rapid	1	2	3	4	5	0
Hance Rapid	1	2	3	4	5	0
Horn Creek Rapid	1	2	3	4	5	0
Hermit Rapid	1	2	3	4	5	0
Crystal Rapid	1	2	3	4	5	0
Lava Falls Rapid	1	2	3	4	5	0

9. Below are a number of characteristics of rapids which you may or may not have experienced on this trip. For each characteristic, please indicate how it affects your enjoyment of a rapid. (CIRCLE ONE NUMBER FOR EACH CHARACTERISTIC)

	Greatly Decreases Enjoyment	Somewhat Decreases Enjoyment	Doesn't Matter	Somewhat Increases Enjoyment	Greatly Increases Enjoyment
Roller coaster ride (standing waves)	1	2	3	4	5
Rapid with large waves	1	2	3	4	5
Rapid with small waves	1	2	3	4	5
Rocks sticking out of water	1	2	3	4	5
Getting hit by water	1	2	3	4	5
Force of the water that hits you	1	2	3	4	5

	Greatly Decreases Enjoyment	Somewhat Decreases Enjoyment	Doesn't Matter	Somewhat Increases Enjoyment	Greatly Increases Enjoyment
Concern about damage to personal equipment	1	2	3	4	5
Hanging onto the boat to avoid being tossed out	1	2	3	4	5
Fear of tipping over	1	2	3	4	5
Fear of falling out of boat and being in the water for a long time	1	2	3	4	5
Large number of rapids	1	2	3	4	5
Long rapid	1	2	3	4	5
Short floating time between rapids	1	2	3	4	5
Waiting at a rapid for other trips to run it	1	2	3	4	5
Having to avoid tricky eddies and holes	1	2	3	4	5
Having to walk around a rapid	1	2	3	4	5
Learning how to "read" rapids from the guide or trip leader	1	2	3	4	5
Paddling/rowing through the rapids	1	2	3	4	5

Other____

Besides rapids, the water level on the river may also affect a person's trip. In this next section, we are interested in your perceptions of the water level during your trip.

---

1. When you were planning your trip, did you know before you left home what the expected water level was for the dates of your trip?

   1 NO

   2 YES--->Did this information about the expected water level have any influence on your decision WHEN to take this trip?

   1 NO

   2 YES (please explain______________ ________________________________)

2. Overall, did you expect the water level on this trip to be:

   1 LOWER THAN IT WAS

   2 ABOUT THE SAME AS IT WAS

   3 HIGHER THAN IT WAS

   4 DIDN'T KNOW WHAT TO EXPECT

3. If you had the choice, would you have preferred the overall water level to be: (CIRCLE ONE NUMBER)

   1 LOWER

   2 ABOUT THE SAME

   3 HIGHER

   4 DON'T KNOW OR DOESN'T MATTER

4. Overall, was the speed of the water (current):

   1 TOO SLOW

   2 TOO FAST

   3 ABOUT RIGHT

   4 DON'T KNOW

5. Did you notice the water level change during your trip?

   1 NO

   2 YES---->How often did you notice it changing? (CIRCLE ONE)

      1 EVERY DAY

      2 ALMOST EVERY DAY

      3 ONLY ON A FEW DAYS

   ---->What made you aware of the water level change?

   ____

6. Do you think that daily fluctuations in the water level would make you feel more or less like you were in a natural setting? (CIRCLE ONE NUMBER)

   1 MUCH MORE LIKE A NATURAL SETTING

   2 SOMEWHAT MORE LIKE A NATURAL SETTING

   3 WOULDN'T HAVE ANY EFFECT

   4 SOMEWHAT LESS LIKE A NATURAL SETTING

   5 MUCH LESS LIKE A NATURAL SETTING

   6 DON'T KNOW

7. Ideally, how often would you prefer that the water level change during a trip? (CIRCLE ONE NUMBER)

   1 EVERY DAY

   2 ALMOST EVERY DAY

   3 ONLY ON A FEW DAYS

   4 NEVER CHANGE

   5 DON'T KNOW

   6 DON'T CARE ABOUT WATER LEVEL CHANGE

In addition to your general feelings about your Grand Canyon trip, we would like to know how you felt about about some specific rapids on this trip.

1. Did you encounter Hance Rapid on your Grand Canyon raft trip?

   1 NO---->Skip to Question 2

   2 DON'T REMEMBER---->Skip to Question 2

   3 YES--->Please indicate whether each of the following statements was true when you were at Hance Rapid. (PLEASE CIRCLE ONE NUMBER FOR EACH STATEMENT)

	Yes	No	Don't Remember
Had to wait for water to rise before running this rapid	1	2	0
Had to wait for water level to drop before running this rapid	1	2	0
Water level was low when we ran this rapid	1	2	0
Water level was medium when we ran this rapid	1	2	0
Water level was high when we ran this rapid	1	2	0
We had large waves when running this rapid	1	2	0
We stopped to scout this rapid before running it	1	2	0
It was difficult to avoid obstacles on this rapid	1	2	0
We had to walk around this rapid	1	2	0

[Hance Rapid is between mile 76 and mile 77, about 11 miles <u>above</u> Phantom Ranch]

2. Did you encounter Crystal Rapid on your Grand Canyon raft trip?

   1 NO---->Skip to Question 3

   2 DON'T REMEMBER---->Skip to Question 3

   3 YES--->Please indicate whether each of the following statements was true when you were at Crystal Rapid (PLEASE CIRCLE ONE NUMBER FOR EACH STATEMENT)

	Yes	No	Don't Remember
Had to wait for water to rise before running this rapid	1	2	0
Had to wait for water level to drop before running this rapid	1	2	0
Water level was low when we ran this rapid	1	2	0
Water level was medium when we ran this rapid	1	2	0
Water level was high when we ran this rapid	1	2	0
We had large waves when running this rapid	1	2	0
We stopped to scout this rapid before running it	1	2	0
It was difficult to avoid obstacles on this rapid	1	2	0
We had to walk around this rapid	1	2	0

[Crystal Rapid is between mile 98 and mile 99 on the river, about 10 miles below Phantom Ranch.]

3. Did you encounter Lava Falls Rapid on your Grand Canyon raft trip?

   1 NO---->Skip to Question 4

   2 DON'T REMEMBER---->Skip to Question 4

   3 YES--->Please indicate whether each of the following statements was true when you were at Lava Falls Rapid. (PLEASE CIRCLE ONE NUMBER FOR EACH STATEMENT)

	Yes	No	Don't Remember
Had to wait for water to rise before running this rapid	1	2	0
Had to wait for water level to drop before running this rapid	1	2	0
Water level was low when we ran this rapid	1	2	0
Water level was medium when we ran this rapid	1	2	0
Water level was high when we ran this rapid1	1	2	0
We had large waves when running this rapid	1	2	0
We stopped to scout this rapid before running it	1	2	0
It was difficult to avoid obstacles on this rapid	1	2	0
We had to walk around this rapid	1	2	0

[Lava Falls Rapid is between mile 179 and mile 180 on the river, about 20 miles below Havasu Creek.]

4. Hance, Hermit, Crystal, and Lava Falls are four rapids which many people remember after a Grand Canyon trip. These rapids are somewhat different at different water levels:

<u>at low water</u>: (9000 CFS or less)	Waves are smaller, water is slower, and some rocks are exposed. Trips sometimes have to wait for several hours for the water level to rise before running the rapid. The guide or trip leader often has to do some tricky maneuvering.
<u>at medium water</u>: (9,000-16,000 CFS)	Waves are somewhat larger and the water is faster. The guide or trip leader does less maneuvering, but there still may be some rocks or obstacles to avoid.
<u>at medium high water</u>: (16,000-32,000 CFS)	The waves are very large and the water is fast. The guide or trip leader often stops to scout the rapid, and may route away from the biggest waves to reduce the risk of flipping the raft.
<u>at high water</u>: (above 32,000 CFS)	Waves are extra large and the probability of flipping oar and paddle rafts is greater. The guide or trip leader usually stops to scout the rapid, and passengers on oar powered trips often walk around the rapid.

If you had your choice of low, medium low, medium high, or high water, which would you prefer for running these four rapids? (CHOOSE ONE)

1 LOW WATER

2 MEDIUM WATER

3 MEDIUM HIGH WATER

4 HIGH WATER

5 MAKES NO DIFFERENCE TO ME

5. As the water level changes, the number and size of rapids are affected. At higher water, there are fewer, but larger rapids. The opposite is true at lower water. If you had to, which of the following situations would you choose on the river? (CHOOSE ONE ONLY)

   1 THE SAME SIZE AND NUMBER I FOUND ON MY TRIP (same water level)

   2 FEWER BUT BIGGER RAPIDS (higher water)

   3 MORE BUT SMALLER RAPIDS (lower water)

   4 MAKES NO DIFFERENCE TO ME AS LONG AS THERE ARE RAPIDS

In this section, we are interested in learning about your guide or trip leader. **[NOTE: If you were the guide or trip leader on this trip, please answer questions 1-3 as you remember doing these things.]**

---

1. Which of the following did you hear the guide or trip leader(s) say they were <u>concerned about</u>? (CIRCLE ALL THAT APPLY)

   1 WATER WAS TOO HIGH

   2 WATER WAS TOO LOW

   3 RAPIDS WERE TOO BIG

   4 LACK OF RAPIDS

   5 TOO MANY OBSTACLES IN THE RAPIDS

   6 FLUCTUATING WATER MADE MOORING DIFFICULT

   7 WATER LEVELS FLUCTUATED TOO MUCH

   8 WATER WAS TOO FAST

   9 WATER WAS TOO SLOW

   10 TOO MUCH TIME SPENT ROWING OR WITH MOTOR ON

   11 LARGE STANDING WAVES

   12 DANGEROUS HOLES OR EDDIES IN THE RAPIDS

   13 NONE OF THE ABOVE

2. Did your guide or trip leader ever tell you to move your tent or gear higher on the beach to avoid water level changes?

   1 YES

   2 NO

3. During your trip, how often do you recall that your guide or trip leader(s) did the following things? (CIRCLE ONE NUMBER FOR EACH ITEM)

	Never Did	Sometimes Did	Often Did	Didn't Notice
Took an easier route to avoid rocks or a big hole	1	2	3	0
Waited above a rapid for water level to change	1	2	3	0
Stopped at a rapid to scout it	1	2	3	0
Waited above a rapid for another party to run it	1	2	3	0
Rowed or motored more than usual to make up some time	1	2	3	0
Rowed or motored less than usual because you were ahead of schedule	1	2	3	0
Hurried to get out of camp in the morning	1	2	3	0
Slept on the boat so mooring could be changed during the night	1	2	3	0
Moved boat mooring during the night	1	2	3	0
Selected certain campsites because the water level might change	1	2	3	0
Had boat(s) float away	1	2	3	0

	Never Did	Sometimes Did	Often Did	Didn't Notice
Had to drag boat(s) off the beach because water level changed during the night	1	2	3	0
Had you walk around a rapid because the water was too high or too low	1	2	3	0

Other____

We are also interested in learning about the campsites, vegetation, beaches, and wildlife you encountered on your raft trip.

---

1. How important were each of the following campsite characteristics to you on your river trip in the Grand Canyon? (CIRCLE ONE NUMBER FOR EACH CHARACTERISTIC)

	Not at all Important	Somewhat Important	Very Important	Didn't Experience
Natural appearance	1	2	3	0
Flat area to sleep on	1	2	3	0
Space between sleeping areas	1	2	3	0
Sandy area to sleep on	1	2	3	0
A flat beach by the river	1	2	3	0
Privacy (change clothes, etc.)	1	2	3	0
Vegetation at beaches	1	2	3	0
Large campsite	1	2	3	0

	Not at all Important	Somewhat Important	Very Important	Didn't Experience
Space for recreation	1	2	3	0
Large boulders/rocks	1	2	3	0
Convenient kitchen setups	1	2	3	0
Shade at camping areas	1	2	3	0
Scenic view of the Canyon	1	2	3	0
Clean, unlittered campsites	1	2	3	0
Place to dock boat(s)	1	2	3	0
Eddies or calm backwater	1	2	3	0
Lack of dead vegetation	1	2	3	0
Few flies or mosquitoes	1	2	3	0
Side canyons for hiking	1	2	3	0
Clear water in side canyons	1	2	3	0
Nearness to river	1	2	3	0
Nearness to rapids	1	2	3	0
Nearness to quiet water	1	2	3	0
Nearby archeological sites	1	2	3	0
Isolation from other groups	1	2	3	0
Presence of wildlife	1	2	3	0

2. Thinking back on your Grand Canyon raft trip, what was the **ONE** most important characteristic of a campsite for you personally? TRY TO BE SPECIFIC.

____

3. Did you ever feel crowded at any of the campsites?

1 NO

2 YES----->Why? (CIRCLE ALL THAT APPLY)

1 OUR GROUP WAS TOO LARGE FOR THE CAMPSITE

2 OTHER GROUPS WERE USING THE CAMPSITE

3 OTHER GROUPS WERE VISIBLE FROM OUR CAMPSITE

4 OTHER (________________________________)

In this last section we would like to ask you some questions about your background which will help us compare your answers to those of other people. We would stress that <u>all</u> of your answers are <u>strictly confidential</u>.

---

1. How old are you? _____years old

2. Are you: 1 MALE

2 FEMALE

3. How many years of school have you completed? (CHOOSE ONE)

1 2 3 4 5 6 7 8 9 10 11 12

____some college or technical school

____B.A. or equivalent

____M.A. or equivalent

____Advanced degree (M.D. Ph.D., etc.)

4. Please circle the response that comes closest to your total family income before taxes. If you are a student and unmarried, please give your parents' income.

1 Less than $10,000
2 $10,000 to $17,499
3 $17,500 to $24,999
4 $25,000 to $32,499
5 $32,500 to $39,999
6 $40,000 to $49,999
7 $50,000 to $59,999
8 $60,000 to $69,999
9 $70,000 to $79,999
10 $80,000 to $89,999
11 $90,000 to $99,999
12 $100,000 or more

THANK YOU FOR YOUR HELP!

______ Check here if you would like a summary of the results of this survey.

Please return this survey in the enclosed envelope to:

HBRS
4513 Vernon Boulevard
Madison, WI 53705

APPENDIX D

WHITE-WATER COMMERCIAL BOATERS CONTINGENT-VALUATION SURVEY

This questionnaire refers to the white water trip you took in the Grand Canyon that started on ______________________________. Please refer to this trip when answering the questions in this survey. It is important that this survey be completed by the person to whom it was sent.

In this first section, we are interested in finding out about your white water trip in the Grand Canyon and how much you enjoyed it.

A1. Overall, how would you rate your white water trip? (CIRCLE ONE NUMBER)

1 POOR

2 FAIR, it just didn't work out very well

3 GOOD, but a number of things could have been different

4 VERY GOOD, but could have been better

5 EXCELLENT, only minor problems

6 PERFECT

A2. Where did you put-in (start trip)? (CIRCLE ONE NUMBER)

1 LEE'S FERRY

2 PHANTOM RANCH

3 OTHER (specify ________________________)

A3. Where did you take-out (end trip)? (CIRCLE ONE NUMBER)

1 PHANTOM RANCH

2 WHITMORE WASH

3 DIAMOND CREEK

4 LAKE MEAD

5 OTHER (specify ________________________)

A4. How long was your trip? __________ DAYS

A5. What type of boat were you on? (CIRCLE ONE NUMBER)

1 MOTOR POWERED RAFT

2 OAR POWERED RAFT

3 COMBINATION MOTOR/OAR RAFT

4 DORY

5 KAYAK

6 PADDLE RAFT

7 OTHER (specify____________________________)

A6. Was your Grand Canyon white water trip: (CIRCLE ONE NUMBER)

1 RUN BY A COMMERCIAL OUTFITTER

2 A PRIVATE TRIP-->Were you primarily responsible for operating a boat on this trip?

1 YES

2 NO

A7. How many times have you taken a white water trip on the Colorado River below Lee's Ferry, <u>including this trip</u>?

__________ TIMES

A8. If you had the opportunity, would you take a Grand Canyon white water trip again? (CIRCLE ONE NUMBER)

1 DEFINITELY NOT

2 PROBABLY NOT

3 PROBABLY YES

4 DEFINITELY YES

A9. On average, how crowded did you feel the river was while you were floating? (Circle the number on the scale best representing your feelings.)

1	2	3	4	5	6	7	8	9
not at all crowded		slightly crowded		moderately crowded			extremely crowded	

Rapids are an important part of the Grand Canyon trip for many people. In this next section, we would like to get your expectations and feelings about the rapids.

A10. What role did rapids play in your decision to take this trip? (CIRCLE ONE NUMBER)

1 RAPIDS WERE THE MOST IMPORTANT REASON FOR TAKING THE TRIP

2 RAPIDS WERE ONE OF THE TWO OR THREE MOST IMPORTANT REASONS FOR TAKING THE TRIP

3 RAPIDS WERE ONLY ONE OF MANY IMPORTANT REASONS FOR TAKING THE TRIP

4 RAPIDS WERE NOT AN IMPORTANT REASON FOR TAKING THE TRIP

A11. Did you have to walk around any rapids?

1 NO

2 YES---->Which rapids?______________________________________

A12. In general, which type of rapid did you enjoy most on this trip: (CHOOSE ONE)

1 BIG RAPIDS

2 MEDIUM RAPIDS

3 SMALL RAPIDS

4 LIKED ALL TYPES OF RAPIDS EQUALLY

5 DON'T LIKE RAPIDS

Besides rapids, the water level on the river may also affect a person's trip. In this next section, we are interested in your feelings about the water level during your trip.

A13. If you had the choice, would you have preferred the overall water level to be: (CIRCLE ONE NUMBER)

1 LOWER

2 ABOUT THE SAME

3 HIGHER

4 DON'T KNOW OR DOESN'T MATTER

A14. Did you notice whether the water level changed during your trip?

1 NO

2 YES---->How often did you notice it changing? (CIRCLE ONE)

1 EVERY DAY

2 ALMOST EVERY DAY

3 ONLY ON A FEW DAYS

---->What made you aware of the water level change?

____

A15. Do you think that daily fluctuations in the water level would make you feel more or less like you were in a natural setting? (CIRCLE ONE NUMBER)

1 MUCH MORE LIKE A NATURAL SETTING

2 SOMEWHAT MORE LIKE A NATURAL SETTING

3 NATURAL SETTING REGARDLESS OF FLUCTUATIONS

4 SOMEWHAT LESS LIKE A NATURAL SETTING

5 MUCH LESS LIKE A NATURAL SETTING

6 DON'T KNOW

A16. If you had a choice, would you have preferred a trip with daily fluctuations in the water level or one with a constant water level? (CIRCLE ONE NUMBER)

1 I WOULD PREFER A TRIP WITH DAILY FLUCTUATIONS

2 I WOULD PREFER A TRIP WITH CONSTANT WATER LEVELS

3 MAKES NO DIFFERENCE TO ME

A17. On your trip, did you feel you had enough time to hike the side canyons and see other attractions? (CIRCLE ONE NUMBER)

1 YES, THERE WAS ENOUGH TIME FOR HIKING

2 NO, THERE WAS NOT ENOUGH TIME FOR HIKING

3 THERE WAS TOO MUCH TIME FOR HIKING

A18. Did you ever have to share the beach where you were camping with other groups during your trip? (CIRCLE ONE NUMBER)

1 NO

2 YES---->How many nights did this happen? (CIRCLE ONE NUMBER)

1 ONE NIGHT

2 TWO NIGHTS

3 THREE NIGHTS

4 FOUR OR MORE NIGHTS

A19. Could you see the camps of other groups from any of your campsites during your last trip? (CIRCLE ONE NUMBER)

1 NO

2 YES---->Were these groups sharing the beach with your group or did they have a separate beach? (CIRCLE ONE)

1 WE SHARED THE BEACH

2 THEY WERE ON A SEPARATE BEACH

A20. If you had a choice, would you prefer a campsite: (CIRCLE ONE)

1 ON THE SAME BEACH AS ANOTHER PARTY

2 WHERE YOU MIGHT BE ABLE TO SEE OR HEAR ANOTHER PARTY

3 OUT OF SIGHT AND HEARING OF OTHERS

In this next section we would like to find out how you traveled to the Grand Canyon and what types of items you purchased for your white water trip. This information will help us to compare your responses with those of other people.

A21. How would you best describe you reason(s) for taking your Grand Canyon white water boat trip? (CIRCLE ONE NUMBER)

1 THE WHITE WATER BOAT TRIP WAS THE ONLY REASON FOR MAKING THE TRIP

2 THE WHITE WATER BOAT TRIP WAS THE MOST IMPORTANT REASON FOR MAKING THE TRIP

3 THE WHITE WATER BOAT TRIP WAS ONE OF SEVERAL EQUALLY IMPORTANT REASONS FOR TAKING THE TRIP

4 THE WHITE WATER BOAT TRIP WAS NOT AN IMPORTANT REASON FOR MAKING THE TRIP

A22. Was any part of your trip to the Grand Canyon by airplane? (CIRCLE ONE NUMBER)

1 YES---->How much time did it take to fly one way?

_____ TOTAL HOURS OF FLYING

2 NO

A23. Did you drive at least part of the way to the Grand Canyon for your white water trip?

1 YES---->How much time did you spend driving one way?

_____ DAY(S) DRIVING _____ TOTAL HOURS OF DRIVING

2 NO----->Skip to **question A26, next page**

A24. What type of vehicle did you use to get to the Grand Canyon? (CIRCLE ONE NUMBER)

1 FULL SIZED AUTOMOBILE

2 INTERMEDIATE SIZED AUTOMOBILE

3 COMPACT AUTOMOBILE

4 SMALL TRUCK (Toyota, Chevy S10, Bronco II, etc.)

5 R.V., FULL SIZE TRUCK, VAN

6 OTHER, (please specify) ________________________________

A25. How many people travelled with you (in the same vehicle) to the Grand Canyon?

MYSELF AND _____ OTHER PEOPLE

A26. Please estimate how much your trip cost (COSTS FOR YOU INDIVIDUALLY, NOT OTHERS FOR WHOM YOU MIGHT HAVE PAID). Include only money spent on items specifically for this trip. If a certain item was not purchased for this trip, please put $0.

Payment to Rafting Company	$________
Airfare	$________
Car Rental	$________
Gas and Oil for vehicle	$________
Food and Beverages (before and after white water trip)	$________
Lodging, Camping (before and after white water trip)	$________
Personal gear (suntan lotion, sun glasses, film for camera)	$________
Other (please specify) ______________ ______________________________	$________
TOTAL AMOUNT TRIP COST (Please add all payments and fill in the total on this line)	$________

A27. Would you still have gone on the Grand Canyon white water trip if your costs had been $_______ **more** than the total you just calculated in Question A26? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

PLEASE READ CAREFULLY

Many factors influence the quality of Grand Canyon white water trips. For example, in a recent survey white water boaters told us that things like good weather, good social interaction, good guides and trip leaders, the number of layovers at attraction sites, running rapids, good food, and many other things would contribute to an excellent or perfect trip. The present survey, however, is focusing specifically on those aspects of the trip that are affected by water flows in the Colorado River.

Water flows in a river like the Colorado are often measured in cubic feet per second (cfs) passing a given point. For our study, water flows are being described in terms of four categories: low flows (5,000 cfs), moderate flows (13,000 cfs), moderately high flows (22,000 cfs), and high flows (40,000 cfs) as measured by releases at Glen Canyon Dam, the last dam above the Grand Canyon. These flow levels are only a few of the many alternative flows that are possible given legal restrictions on releases from Glen Canyon Dam and they are being used here to find out about your preference for various Colorado river flows through the Grand Canyon.

The amount of water being released from Glen Canyon Dam can also vary from time to time within any one day. These daily fluctuations, when they occur, typically follow a regular pattern. Flow releases from the Dam increase during the morning to provide high water during the afternoon, and decrease in the late afternoon and evening, resulting in low water at night and in the early morning hours.

In the case descriptions that follow, we will describe the effects of each of these types of flow patterns. For each type of flow we would like you to tell us how it would affect the quality of a Grand Canyon white water trip for you. A previous study of boating in the Grand Canyon shows that white water boaters tend to give a high rating to their trip regardless of the flow they actually experienced. However, most boaters were able to indicate a preference for one type of flow over others. Information from this previous survey is presented as an aid in your evaluation of different river conditions and represents the general opinion of boaters in our previous study. Your opinion about water levels, however, may be different. For each type of condition, we would like you to tell us how the river flow would affect the quality of your white water trip.

Your white water trip in the Grand Canyon started on _________. Records show that during your trip the average water level was about __________ cfs, with daily changes ranging from an average daily low of __________ cfs to an average daily high flow of ______________cfs.

CASE 1

At a constant flow of 5,000 cfs, the speed of the river is relatively slow, reducing time for side canyon visits and other attractions. Boaters must break camp early to stay on schedule. Although rapids are present at this low water level, the waves are smaller and do not produce the big "roller coaster" ride created by higher flows. Due to exposed rocks, some rapids may be so difficult that it is likely passengers would have to walk around them. However, camping opportunities are abundant with many large sandy beaches exposed.

B1. Do you think a Grand Canyon white water trip under the conditions described for Case 1 above would be better or worse than your last Grand Canyon white water trip? (CIRCLE ONE NUMBER)

1 MUCH BETTER

2 SOMEWHAT BETTER

3 ABOUT THE SAME

4 SOMEWHAT WORSE

5 MUCH WORSE

We would now like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the same people, same food, etc.) with <u>two exceptions</u>:

The water level would be constant at 5,000 cfs (see Case 1 above)

AND

<u>Your individual</u> costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

B2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 2

With flows fluctuating daily from 1,000 to 17,000 cfs, around an average daily flow of 5,000 cfs, most people are aware of changes in the water level. Trip speed is relatively slow, reducing time for side canyon visits, and boaters must break camp early to stay on schedule. Large sandy beaches are generally abundant, but boatmen must take care selecting mooring sites. Occasionally, due to low water in the morning, gear will have to be carried a long ways (perhaps across slippery rocks) to be loaded on the boats. Boatmen may have to wait above certain rapids for the water to rise, or hurry to get to a rapid before the water falls. Due to exposed rocks, some rapids may be so difficult that it is likely passengers would have to walk around them. At other rapids, however, higher flows may produce large waves and a bigger "roller coaster" ride than at a low constant flow.

B3. If you had to choose, which would you prefer: low water with small or no fluctuations or low water with large daily fluctuations? (CIRCLE ONE NUMBER)

1 LOW WATER WITH SMALL OR NO FLUCTUATIONS

2 LOW WATER WITH LARGE DAILY FLUCTUATIONS

3 MAKES NO DIFFERENCE TO ME

Now imagine that you are deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the people, food, etc.) with <u>two exceptions</u>:

There would be large daily fluctuations from a low flow of 1,000 cfs to a high flow of 17,000 cfs around an average of 5,000 cfs (see description for Case 2 above)

AND

<u>Your individual</u> costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

B4. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 3

At moderate water levels (around 13,000 cfs), the pace of the river is slightly faster than at low flows, leaving a little more time for hiking in side canyons and stops at attractions. Most boating groups will not have a problem staying on schedule. Rapids tend to have larger waves and provide a little more of a "roller coaster" ride than at low water. Passengers may have to walk around only a few rapids. Campsites are still large and plentiful.

C1. Do you think a Grand Canyon white water trip under the conditions described for Case 3 above would be better or worse than your last Grand Canyon white water trip? (CIRCLE ONE NUMBER)

1 MUCH BETTER

2 SOMEWHAT BETTER

3 ABOUT THE SAME

4 SOMEWHAT WORSE

5 MUCH WORSE

We would now like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your trip (e.g., the same people, same food, etc.) with two exceptions:

The water level would be constant at 13,000 cfs (see description for Case 3 above)

AND

Your individual costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

C2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 4

At moderately high water levels (around 22,000 cfs), the pace of the river is faster than at lower flows, leaving more time for side canyons and stops at attractions. Boating groups do not have a problem staying on schedule. Rapids have larger waves and provide a bigger "roller coaster" ride than at moderate water. Only a few passengers choose to walk around some of the bigger rapids for their safety. Some potential campsites are under water in some areas of the canyon, but generally campsites are plentiful although a bit smaller in size.

D1. Do you think a Grand Canyon white water trip under these conditions (Case 4 above) would be better or worse than your last Grand Canyon white water trip? (CIRCLE ONE NUMBER)

1 MUCH BETTER

2 SOMEWHAT BETTER

3 ABOUT THE SAME

4 SOMEWHAT WORSE

5 MUCH WORSE

We would now like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the people, food, etc.) with <u>two exceptions</u>:

The water level would be constant at 22,000 cfs (see description for Case 4 above)

AND

<u>Your individual</u> costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

D2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 5

With large daily fluctuations from 10,000 cfs - 31,500 cfs, around an average daily flow of 22,000 cfs, most people are aware of water level changes. The boatmen will have to take more care in selecting mooring and camping sites. Due to low water levels in the morning, gear may have to be carried (perhaps across rocky areas) to be loaded on the boats. Boatmen may decide to wait above certain rapids for the water level to rise or may have to hurry to get to a certain rapid before the water level falls. In addition, some rapids may be difficult due to exposed rocks at low water levels and other rapids might be quite large at high water levels, and it is likely that passengers may have to walk around a few rapids. When the water is high or rising, however, the standing waves in some of the major rapids become larger, resulting in a bigger "roller coaster" ride.

D3. If you had to choose, which would you prefer: moderately high water with small or no fluctuations or moderately high water with large daily fluctuations? (CIRCLE ONE NUMBER)

1 MODERATELY HIGH WATER WITH SMALL OR NO FLUCTUATIONS

2 MODERATELY HIGH WATER WITH LARGE DAILY FLUCTUATIONS

3 MAKES NO DIFFERENCE TO ME

Now imagine that you are deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the people, food, etc.) with <u>two exceptions</u>:

There would be large daily fluctuations from a low flow of 10,000 cfs to a high flow of 31,500 cfs around an average of 22,000 cfs (see description for Case 5 above)

AND

<u>Your individual</u> costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

D4. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 6

At high water levels (around 40,000 cfs), the current is fast. Trips are able to stop at additional side canyons and spend additional time at attraction sites. Fewer rapids are present, as some of the smaller rapids are "washed out." In other rapids, however, the waves are very large and some passengers, especially those on oar powered trips, face an increased likelihood of having to walk around one or more of the major rapids for their safety. Campsites become more scarce as sandbars and shore areas are flooded, and campsites are much smaller. In some areas of the Canyon, there is an increased chance of camping with or near other groups.

E1. Do you think a Grand Canyon white water trip under the conditions described above for Case 6 would be better or worse than your last Grand Canyon white water trip?

1 MUCH BETTER

2 SOMEWHAT BETTER

3 ABOUT THE SAME

4 SOMEWHAT WORSE

5 MUCH WORSE

We would now like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the people, food, etc.) with <u>two exceptions</u>:

The water level would be constant at 40,000 cfs (see Case 6 above)

AND

<u>Your individual</u> costs for the trip increased by $_______ (over the total cost you calculated on page 8, question A26)

E2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 7

There are indications that certain types of flow patterns in the long run may reduce the number of sandy beaches in the Grand Canyon. At present, the area between Hance Rapids and Havasu has fewer beaches than other parts of the canyon. Trip leaders must plan schedules very closely to ensure a good campsite in this area. As beaches disappear, this careful planning would have to be extended to other parts of the canyon.

This planning might mean missing some attraction sites to get to camp early or longer stops at some attraction sites. Fewer beaches would increase the likelihood of camping near other parties and perhaps sharing a beach with other parties. Some camps might have to be made in areas without any sand.

F1. If the number of beaches in the Grand Canyon were substantially reduced, the effects described above would become much more likely. We would like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. All of the details of this trip would be the same as your last trip <u>with two exceptions</u>:

The number of beaches was substantially reduced (see Case 7 above)

AND

<u>Your individual</u> costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

F2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

In the previous case descriptions there were a number of different questions where we asked whether you would still take the white water trip if your expenses increased by a certain dollar amount.

To help us better understand your responses, we would like to know the extent to which various factors affected your answers. Please tell us whether the following statements were true or not for you when answering those questions. (CIRCLE ONE RESPONSE FOR EACH STATEMENT)

	Definitely True	Probably True	Probably False	Definitely False
G1. My main concern was that the Park Service might start charging a fee for private Grand Canyon white water trips.	1	2	3	4
G2. My main concern was that rafting companies might increase the price of commercial Grand Canyon white water trips.	1	2	3	4
G3. My responses reflected my best guess as to whether I would pay the specified amounts for the Grand Canyon white water trip.	1	2	3	4
G4. My responses reflected the fact that I feel the Grand Canyon white water boating experience should be maintained for all people to enjoy.	1	2	3	4
G5. I just don't know how much more I would really pay for a Grand Canyon white water trip regardless of the conditions.	1	2	3	4
G6. I just don't want to have to pay more for a Grand Canyon white water trip regardless of what the conditions would be.	1	2	3	4

G7. Other, please describe: ______________________________

____

In this final section, we would like to ask some questions about your background which will help us compare your answers with those of other people. We stress that <u>all</u> of your answers are strictly confidential.

H1. How old are you? ______ YEARS OLD

H2. Are you: 1 MALE

2 FEMALE

H3. How many years of school have you completed? (CIRCLE OR CHECK THE HIGHEST YEAR OR LEVEL)

1 2 3 4 5 6 7 8 9 10 11 12

_____Some college

_____B.A. or equivalent

_____M.A., M.S.

_____Advanced degree (J.D., M.D., Ph.D)

H4. Please circle the response that comes closest to your total family income before taxes. (CIRCLE ONE NUMBER)

1 Less than $10,000
2 $10,000 to $14,999
3 $15,000 to $19,999
4 $20,000 to $24,999
5 $25,000 to $29,999
6 $30,000 to $34,999
7 $35,000 to $39,999
8 $40,000 to $44,999
9 $45,000 to $49,999
10 $50,000 to $59,999
11 $60,000 to $69,999
12 $70,000 to $79,999
13 $80,000 to $89,999
14 $90,000 to $99,999
15 $100,000 or more

H5. With reference to your primary occupation, are you currently (CIRCLE ONE NUMBER):

1 EMPLOYED FULL-TIME

2 EMPLOYED PART-TIME

3 FULL-TIME HOMEMAKER

4 TEMPORARILY UNEMPLOYED

5 NOT EMPLOYED, NOT LOOKING FOR WORK

6 RETIRED, NOT WORKING

7 RETIRED, WORKING PART-TIME

_____ Check here if you would like a copy of results

THANK YOU FOR YOUR HELP!

Please return this survey in the enclosed envelope to:

HBRS
4513 Vernon Boulevard
Madison, WI 53705

APPENDIX E

WHITE-WATER PRIVATE BOATERS CONTINGENT-VALUATION SURVEY

This questionnaire refers to the white water trip you took in the Grand Canyon that started on ______________________________. Please refer to this trip when answering the questions in this survey. It is important that this survey be completed by the person to whom it was sent.

In this first section, we are interested in finding out about your white water trip in the Grand Canyon and how much you enjoyed it.

A1. Overall, how would you rate your white water trip? (CIRCLE ONE NUMBER)

1 POOR

2 FAIR, it just didn't work out very well

3 GOOD, but a number of things could have been different

4 VERY GOOD, but could have been better

5 EXCELLENT, only minor problems

6 PERFECT

A2. Where did you put-in (start trip)? (CIRCLE ONE NUMBER)

1 LEE'S FERRY

2 PHANTOM RANCH

3 OTHER (specify ________________________)

A3. Where did you take-out (end trip)? (CIRCLE ONE NUMBER)

1 PHANTOM RANCH

2 WHITMORE WASH

3 DIAMOND CREEK

4 LAKE MEAD

5 OTHER (specify ________________________)

A4. How long was your trip? __________ DAYS

A5. What type of boat were you on? (CIRCLE ONE NUMBER)

1 MOTOR POWERED RAFT

2 OAR POWERED RAFT

3 COMBINATION MOTOR/OAR RAFT

4 DORY

5 KAYAK

6 PADDLE RAFT

7 OTHER (specify____________________________)

A6. Was your Grand Canyon white water trip: (CIRCLE ONE NUMBER)

1 RUN BY A COMMERCIAL OUTFITTER

2 A PRIVATE TRIP-->Were you primarily responsible for operating a boat on this trip?

1 YES

2 NO

A7. How many times have you taken a white water trip on the Colorado River below Lee's Ferry, including this trip?

__________ TIMES

A8. If you had the opportunity, would you take a Grand Canyon white water trip again? (CIRCLE ONE NUMBER)

1 DEFINITELY NOT

2 PROBABLY NOT

3 PROBABLY YES

4 DEFINITELY YES

A9. On average, how crowded did you feel the river was while you were floating? (Circle the number on the scale best representing your feelings.)

1	2	3	4	5	6	7	8	9
not at all crowded		slightly crowded		moderately crowded			extremely crowded	

Rapids are an important part of the Grand Canyon trip for many people. In this next section, we would like to get your expectations and feelings about the rapids.

A10. What role did rapids play in your decision to take this trip? (CIRCLE ONE NUMBER)

1 RAPIDS WERE THE MOST IMPORTANT REASON FOR TAKING THE TRIP

2 RAPIDS WERE ONE OF THE TWO OR THREE MOST IMPORTANT REASONS FOR TAKING THE TRIP

3 RAPIDS WERE ONLY ONE OF MANY IMPORTANT REASONS FOR TAKING THE TRIP

4 RAPIDS WERE NOT AN IMPORTANT REASON FOR TAKING THE TRIP

A11. Did you have to walk around any rapids?

1 NO

2 YES---->Which rapids?________________________________

A12. In general, which type of rapid did you enjoy most on this trip: (CHOOSE ONE)

1 BIG RAPIDS

2 MEDIUM RAPIDS

3 SMALL RAPIDS

4 LIKED ALL TYPES OF RAPIDS EQUALLY

5 DON'T LIKE RAPIDS

Besides rapids, the water level on the river may also affect a person's trip. In this next section, we are interested in your feelings about the water level during your trip.

A13. If you had the choice, would you have preferred the overall water level to be: (CIRCLE ONE NUMBER)

1 LOWER

2 ABOUT THE SAME

3 HIGHER

4 DON'T KNOW OR DOESN'T MATTER

A14. Did you notice whether the water level changed during your trip?

1 NO

2 YES---->How often did you notice it changing? (CIRCLE ONE)

1 EVERY DAY

2 ALMOST EVERY DAY

3 ONLY ON A FEW DAYS

---->What made you aware of the water level change?

____

A15. Do you think that daily fluctuations in the water level would make you feel more or less like you were in a natural setting? (CIRCLE ONE NUMBER)

1 MUCH MORE LIKE A NATURAL SETTING

2 SOMEWHAT MORE LIKE A NATURAL SETTING

3 NATURAL SETTING REGARDLESS OF FLUCTUATIONS

4 SOMEWHAT LESS LIKE A NATURAL SETTING

5 MUCH LESS LIKE A NATURAL SETTING

6 DON'T KNOW

A16. If you had a choice, would you have preferred a trip with daily fluctuations in the water level or one with a constant water level? (CIRCLE ONE NUMBER)

1 I WOULD PREFER A TRIP WITH DAILY FLUCTUATIONS

2 I WOULD PREFER A TRIP WITH CONSTANT WATER LEVELS

3 MAKES NO DIFFERENCE TO ME

A17. On your trip, did you feel you had enough time to hike the side canyons and see other attractions? (CIRCLE ONE NUMBER)

1 YES, THERE WAS ENOUGH TIME FOR HIKING

2 NO, THERE WAS NOT ENOUGH TIME FOR HIKING

3 THERE WAS TOO MUCH TIME FOR HIKING

A18. Did you ever have to share the beach where you were camping with other groups during your trip? (CIRCLE ONE NUMBER)

1 NO

2 YES---->How many nights did this happen? (CIRCLE ONE NUMBER)

   1 ONE NIGHT

   2 TWO NIGHTS

   3 THREE NIGHTS

   4 FOUR OR MORE NIGHTS

A19. Could you see the camps of other groups from any of your campsites during your last trip? (CIRCLE ONE NUMBER)

1 NO

2 YES---->Were these groups sharing the beach with your group or did they have a separate beach? (CIRCLE ONE)

1 WE SHARED THE BEACH

2 THEY WERE ON A SEPARATE BEACH

A20. If you had a choice, would you prefer a campsite: (CIRCLE ONE)

1 ON THE SAME BEACH AS ANOTHER PARTY

2 WHERE YOU MIGHT BE ABLE TO SEE OR HEAR ANOTHER PARTY

3 OUT OF SIGHT AND HEARING OF OTHERS

In this next section we would like to find out how you traveled to the Grand Canyon and what types of items you purchased for your white water trip. This information will help us to compare your responses with those of other people.

A21. How would you best describe you reason(s) for taking your Grand Canyon white water boat trip? (CIRCLE ONE NUMBER)

1 THE WHITE WATER BOAT TRIP WAS THE ONLY REASON FOR MAKING THE TRIP

2 THE WHITE WATER BOAT TRIP WAS THE MOST IMPORTANT REASON FOR MAKING THE TRIP

3 THE WHITE WATER BOAT TRIP WAS ONE OF SEVERAL EQUALLY IMPORTANT REASONS FOR TAKING THE TRIP

4 THE WHITE WATER BOAT TRIP WAS NOT AN IMPORTANT REASON FOR MAKING THE TRIP

A22. Was any part of your trip to the Grand Canyon by airplane? (CIRCLE ONE NUMBER)

1 YES---->How much time did it take to fly <u>one way</u>?

_____ TOTAL HOURS OF FLYING

2 NO

A23. Did you drive at least part of the way to the Grand Canyon for your white water trip?

1 YES---->How much time did you spend driving <u>one way</u>?

_____ DAY(S) DRIVING _____ TOTAL HOURS OF DRIVING

2 NO------>Skip to **question A26, next page**

A24. What type of vehicle did you use to get to the Grand Canyon? (CIRCLE ONE NUMBER)

1 FULL SIZED AUTOMOBILE

2 INTERMEDIATE SIZED AUTOMOBILE

3 COMPACT AUTOMOBILE

4 SMALL TRUCK (Toyota, Chevy S10, Bronco II, etc.)

5 R.V., FULL SIZE TRUCK, VAN

6 OTHER, (please specify) _________________________________

A25. How many people travelled with you (in the same vehicle) to the Grand Canyon?

MYSELF AND _____ OTHER PEOPLE

A26. Please estimate how much your trip cost (COSTS FOR YOU INDIVIDUALLY, EITHER PAID BY YOURSELF OR BY OTHERS). Include only money spent on items specifically for this trip. If a certain item was not purchased for this trip, please put $0.

Gas and Oil for vehicle	$________
Airfare	$________
Car Rental	$________
Food and Beverages	$________
Personal gear (suntan lotion, sun glasses, film for camera)	$________
Lodging, Camping (before and after white water trip)	$________
Boat Gear (oars, lines, etc.)	$________
Equipment rental	$________
Take out at Diamond Creek	$________
Vehicle shuttle	$________
Tow across Lake Mead	$________
Other (please specify) ________________ ______________________________	$________
TOTAL AMOUNT TRIP COST (Please add all payments and fill in the total on this line)	$________

A27. Would you still have gone on the Grand Canyon white water trip if your costs had been $_______ **more** than the total you just calculated in Question A26? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

PLEASE READ CAREFULLY

Many factors influence the quality of Grand Canyon white water trips. For example, in a recent survey white water boaters told us that things like good weather, good social interaction, good guides and trip leaders, the number of layovers at attraction sites, running rapids, good food, and many other things would contribute to an excellent or perfect trip. The present survey, however, is focusing specifically on those aspects of the trip that are affected by water flows in the Colorado River.

Water flows in a river like the Colorado are often measured in cubic feet per second (cfs) passing a given point. For our study, water flows are being described in terms of four categories: low flows (5,000 cfs), moderate flows (13,000 cfs), moderately high flows (22,000 cfs), and high flows (40,000 cfs) as measured by releases at Glen Canyon Dam, the last dam above the Grand Canyon. These flow levels are only a few of the many alternative flows that are possible given legal restrictions on releases from Glen Canyon Dam and they are being used here to find out about your preference for various Colorado river flows through the Grand Canyon.

The amount of water being released from Glen Canyon Dam can also vary from time to time within any one day. These daily fluctuations, when they occur, typically follow a regular pattern. Flow releases from the Dam increase during the morning to provide high water during the afternoon, and decrease in the late afternoon and evening, resulting in low water at night and in the early morning hours.

In the case descriptions that follow, we will describe the effects of each of these types of flow patterns. For each type of flow we would like you to tell us how it would affect the quality of a Grand Canyon white water trip for you. A previous study of boating in the Grand Canyon shows that white water boaters tend to give a high rating to their trip regardless of the flow they actually experienced. However, most boaters were able to indicate a preference for one type of flow over others. Information from this previous survey is presented as an aid in your evaluation of different river conditions and represents the general opinion of boaters in our previous study. Your opinion about water levels, however, may be different. For each type of condition, we would like you to tell us how the river flow would affect the quality of your white water trip.

Your white water trip in the Grand Canyon started on ________. Records show that during your trip the average water level was about ________ cfs, with daily changes ranging from an average daily low of ________ cfs to an average daily high flow of ____________cfs.

CASE 1

At a constant flow of 5,000 cfs, the speed of the river is relatively slow, reducing time for side canyon visits and other attractions. Boaters must break camp early to stay on schedule. Although rapids are present at this low water level, the waves are smaller and do not produce the big "roller coaster" ride created by higher flows. Due to exposed rocks, some rapids may be so difficult that it is likely passengers would have to walk around them. However, camping opportunities are abundant with many large sandy beaches exposed.

B1. Do you think a Grand Canyon white water trip under the conditions described for Case 1 above would be better or worse than your last Grand Canyon white water trip? (CIRCLE ONE NUMBER)

1 MUCH BETTER

2 SOMEWHAT BETTER

3 ABOUT THE SAME

4 SOMEWHAT WORSE

5 MUCH WORSE

We would now like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the same people, same food, etc.) with <u>two exceptions</u>:

The water level would be constant at 5,000 cfs (see Case 1 above)

AND

<u>Your individual</u> costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

B2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 2

With flows fluctuating daily from 1,000 to 17,000 cfs, around an average daily flow of 5,000 cfs, most people are aware of changes in the water level. Trip speed is relatively slow, reducing time for side canyon visits, and boaters must break camp early to stay on schedule. Large sandy beaches are generally abundant, but boatmen must take care selecting mooring sites. Occasionally, due to low water in the morning, gear will have to be carried a long ways (perhaps across slippery rocks) to be loaded on the boats. Boatmen may have to wait above certain rapids for the water to rise, or hurry to get to a rapid before the water falls. Due to exposed rocks, some rapids may be so difficult that it is likely passengers would have to walk around them. At other rapids, however, higher flows may produce large waves and a bigger "roller coaster" ride than at a low constant flow.

B3. If you had to choose, which would you prefer: low water with small or no fluctuations or low water with large daily fluctuations? (CIRCLE ONE NUMBER)

1 LOW WATER WITH SMALL OR NO FLUCTUATIONS

2 LOW WATER WITH LARGE DAILY FLUCTUATIONS

3 MAKES NO DIFFERENCE TO ME

Now imagine that you are deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the people, food, etc.) with two exceptions:

There would be large daily fluctuations from a low flow of 1,000 cfs to a high flow of 17,000 cfs around an average of 5,000 cfs (see description for Case 2 above)

AND

Your individual costs for the trip increased by $_______ (over the total cost you calculated on page 8, question A26)

B4. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 3

At moderate water levels (around 13,000 cfs), the pace of the river is slightly faster than at low flows, leaving a little more time for hiking in side canyons and stops at attractions. Most boating groups will not have a problem staying on schedule. Rapids tend to have larger waves and provide a little more of a "roller coaster" ride than at low water. Passengers may have to walk around only a few rapids. Campsites are still large and plentiful.

C1. Do you think a Grand Canyon white water trip under the conditions described for Case 3 above would be better or worse than your last Grand Canyon white water trip? (CIRCLE ONE NUMBER)

1 MUCH BETTER
2 SOMEWHAT BETTER
3 ABOUT THE SAME
4 SOMEWHAT WORSE
5 MUCH WORSE

We would now like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your trip (e.g., the same people, same food, etc.) with two exceptions:

The water level would be constant at 13,000 cfs (see description for Case 3 above)

AND

Your individual costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

C2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP
2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 4

At moderately high water levels (around 22,000 cfs), the pace of the river is faster than at lower flows, leaving more time for side canyons and stops at attractions. Boating groups do not have a problem staying on schedule. Rapids have larger waves and provide a bigger "roller coaster" ride than at moderate water. Only a few passengers choose to walk around some of the bigger rapids for their safety. Some potential campsites are under water in some areas of the canyon, but generally campsites are plentiful although a bit smaller in size.

D1. Do you think a Grand Canyon white water trip under these conditions (Case 4 above) would be better or worse than your last Grand Canyon white water trip? (CIRCLE ONE NUMBER)

1 MUCH BETTER

2 SOMEWHAT BETTER

3 ABOUT THE SAME

4 SOMEWHAT WORSE

5 MUCH WORSE

We would now like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the people, food, etc.) with <u>two exceptions</u>:

The water level would be constant at 22,000 cfs (see description for Case 4 above)

AND

<u>Your individual</u> costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

D2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 5

With large daily fluctuations from 10,000 cfs - 31,500 cfs, around an average daily flow of 22,000 cfs, most people are aware of water level changes. The boatmen will have to take more care in selecting mooring and camping sites. Due to low water levels in the morning, gear may have to be carried (perhaps across rocky areas) to be loaded on the boats. Boatmen may decide to wait above certain rapids for the water level to rise or may have to hurry to get to a certain rapid before the water level falls. In addition, some rapids may be difficult due to exposed rocks at low water levels and other rapids might be quite large at high water levels, and it is likely that passengers may have to walk around a few rapids. When the water is high or rising, however, the standing waves in some of the major rapids become larger, resulting in a bigger "roller coaster" ride.

D3. If you had to choose, which would you prefer: moderately high water with small or no fluctuations or moderately high water with large daily fluctuations? (CIRCLE ONE NUMBER)

1 MODERATELY HIGH WATER WITH SMALL OR NO FLUCTUATIONS

2 MODERATELY HIGH WATER WITH LARGE DAILY FLUCTUATIONS

3 MAKES NO DIFFERENCE TO ME

Now imagine that you are deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the people, food, etc.) with <u>two exceptions</u>:

There would be large daily fluctuations from a low flow of 10,000 cfs to a high flow of 31,500 cfs around an average of 22,000 cfs (see description for Case 5 above)

AND

<u>Your individual</u> costs for the trip increased by $_______ (over the total cost you calculated on page 8, question A26)

D4. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 6

At high water levels (around 40,000 cfs), the current is fast. Trips are able to stop at additional side canyons and spend additional time at attraction sites. Fewer rapids are present, as some of the smaller rapids are "washed out." In other rapids, however, the waves are very large and some passengers, especially those on oar powered trips, face an increased likelihood of having to walk around one or more of the major rapids for their safety. Campsites become more scarce as sandbars and shore areas are flooded, and campsites are much smaller. In some areas of the Canyon, there is an increased chance of camping with or near other groups.

E1. Do you think a Grand Canyon white water trip under the conditions described above for Case 6 would be better or worse than your last Grand Canyon white water trip?

1 MUCH BETTER

2 SOMEWHAT BETTER

3 ABOUT THE SAME

4 SOMEWHAT WORSE

5 MUCH WORSE

We would now like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. Imagine that the trip would be the same as your last trip (e.g., the people, food, etc.) with two exceptions:

The water level would be constant at 40,000 cfs (see Case 6 above)

AND

Your individual costs for the trip increased by $_______ (over the total cost you calculated on page 8, question A26)

E2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

CASE 7

There are indications that certain types of flow patterns in the long run may reduce the number of sandy beaches in the Grand Canyon. At present, the area between Hance Rapids and Havasu has fewer beaches than other parts of the canyon. Trip leaders must plan schedules very closely to ensure a good campsite in this area. As beaches disappear, this careful planning would have to be extended to other parts of the canyon.

This planning might mean missing some attraction sites to get to camp early or longer stops at some attraction sites. Fewer beaches would increase the likelihood of camping near other parties and perhaps sharing a beach with other parties. Some camps might have to be made in areas without any sand.

F1. If the number of beaches in the Grand Canyon were substantially reduced, the effects described above would become much more likely. We would like you to imagine that you are presently deciding whether or not to go on a Grand Canyon white water trip. All of the details of this trip would be the same as your last trip <u>with two exceptions</u>:

The number of beaches was substantially reduced (see Case 7 above)

AND

<u>Your individual</u> costs for the trip increased by $______ (over the total cost you calculated on page 8, question A26)

F2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THIS AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THIS AMOUNT TO TAKE THE TRIP

In the previous case descriptions there were a number of different questions where we asked whether you would still take the white water trip if your expenses increased by a certain dollar amount.

To help us better understand your responses, we would like to know the extent to which various factors affected your answers. Please tell us whether the following statements were true or not for you when answering those questions. (CIRCLE ONE RESPONSE FOR EACH STATEMENT)

	Definitely True	Probably True	Probably False	Definitely False
G1. My main concern was that the Park Service might start charging a fee for private Grand Canyon white water trips.	1	2	3	4
G2. My main concern was that rafting companies might increase the price of commercial Grand Canyon white water trips.	1	2	3	4
G3. My responses reflected my best guess as to whether I would pay the specified amounts for the Grand Canyon white water trip.	1	2	3	4
G4. My responses reflected the fact that I feel the Grand Canyon white water boating experience should be maintained for all people to enjoy.	1	2	3	4
G5. I just don't know how much more I would really pay for a Grand Canyon white water trip regardless of the conditions.	1	2	3	4
G6. I just don't want to have to pay more for a Grand Canyon white water trip regardless of what the conditions would be.	1	2	3	4

G7. Other, please describe: ____

____

In this section we would like to know how you evaluate the chance of a boat flipping in specific rapids at specific flow levels.

H1. It has been suggested that the flow level in the river might affect the likelihood of boating accidents in the rapids. We would like your judgment as to the risk of flipping a boat (the type of boat **you** used for your 1985 Grand Canyon white water trip) in two specific rapids, under four different flow conditions.

Imagine that 100 boats of your type were run, by "average" boaters, through Crystal rapid at flows in the range of 3,000 to 9,000 cfs. How many of these boats do you think would flip? You would answer "zero" if you felt that none of these boats would flip in Crystal at these flows, and "100" if you feel that all of these boats would flip at these flows. Answering "50", for example, would indicate you believe that roughly half of the boats like yours would flip in Crystal at these flows. Please give us your best judgment (between 0 and 100) of the chance of flipping in these two rapids at the four flow conditions shown below. (PLEASE FILL IN THE BLANK FOR EACH CATEGORY)

HANCE RAPID: _____ boats out of every 100 would flip at daily flows between **3,000 and 9,000 cfs**

_____ boats out of every 100 would flip at daily flows between **10,000 and 15,000 cfs**

_____ boats out of every 100 would flip at daily flows between **16,000 and 31,000 cfs**

_____ boats out of every 100 would flip at daily flows greater **than 32,000 cfs**

CRYSTAL RAPID: _____ boats out of every 100 would flip at daily flows between **3,000 and 9,000 cfs**

_____ boats out of every 100 would flip at daily flows between **10,000 and 15,000 cfs**

_____ boats out of every 100 would flip at daily flows between **16,000 and 31,000 cfs**

_____ boats out of every 100 would flip at daily flows greater **than 32,000 cfs**

H2. For question **H1** you filled in eight numbers describing how many boats like yours might flip under various conditions. We would now like to know, in your judgment, if any of the numbers you reported in question **H1** are so high that you would have serious concerns about running the rapid(s) under those conditions. Please indicate whether the chances you reported of flipping are acceptable or unacceptable. (CIRCLE ONE NUMBER FOR EACH CATEGORY).

The chances I reported of flipping in **HANCE RAPID** are:

Acceptable	Unacceptable	
1	2	at a daily flow of **3,000 to 9,000 cfs**
1	2	at daily flows between **10,000 and 15,000 cfs**
1	2	at daily flows between **16,000 and 31,000 cfs**
1	2	at daily flows greater than 32,000 **cfs**

The chances I reported of flipping in **CRYSTAL RAPID** are:

Acceptable	Unacceptable	
1	2	at a daily flow of **3,000 to 9,000 cfs**
1	2	at daily flows between **10,000 and 15,000 cfs**
1	2	at daily flows between **16,000 and 31,000 cfs**
1	2	at daily flows greater than 32,000 **cfs**

In this final section, we would like to ask some questions about your background which will help us compare your answers with those of other people. We stress that all of your answers are strictly confidential.

I1. How old are you? ______ YEARS OLD

I2. Are you: 1 MALE

2 FEMALE

I3. How many years of school have you completed? (CIRCLE OR CHECK THE HIGHEST YEAR OR LEVEL)

1 2 3 4 5 6 7 8 9 10 11 12

_____Some college

_____B.A. or equivalent

_____M.A., M.S.

_____Advanced degree (J.D., M.D., Ph.D)

I4. Please circle the response that comes closest to your total family income before taxes. (CIRCLE ONE NUMBER)

1 Less than $10,000
2 $10,000 to $14,999
3 $15,000 to $19,999
4 $20,000 to $24,999
5 $25,000 to $29,999
6 $30,000 to $34,999
7 $35,000 to $39,999
8 $40,000 to $44,999
9 $45,000 to $49,999
10 $50,000 to $59,999
11 $60,000 to $69,999
12 $70,000 to $79,999
13 $80,000 to $89,999
14 $90,000 to $99,999
15 $100,000 or more

I5. With reference to your primary occupation, are you currently (CIRCLE ONE NUMBER):

1 EMPLOYED FULL-TIME

2 EMPLOYED PART-TIME

3 FULL-TIME HOMEMAKER

4 TEMPORARILY UNEMPLOYED

5 NOT EMPLOYED, NOT LOOKING FOR WORK

6 RETIRED, NOT WORKING

7 RETIRED, WORKING PART-TIME

_____ Check here if you would like a copy of results

THANK YOU FOR YOUR HELP!

Please return this survey in the enclosed envelope to:

HBRS
4513 Vernon Boulevard
Madison, WI 53705

APPENDIX F

GLEN CANYON ANGLERS ON-SITE ATTRIBUTE SURVEY

Lee's Ferry Fishing Survey

1) Overall, how was your fishing trip today?

1 POOR
2 FAIR, it just didn't work out very well
3 GOOD, but I wish a number of things could have been different
4 VERY GOOD, but could have been better
5 EXCELLENT, only minor problems
6 PERFECT

2) How important were each of the following reasons in your decision to come to Lee's Ferry to fish rather than going elsewhere? (CIRCLE ONE NUMBER FOR EACH REASON)

	Not Important	Somewhat Important	Very Important
Thought I would catch a lot of fish	1	2	3
Thought I would catch big fish	1	2	3
Wanted to fish in Glen Canyon	1	2	3
Close to home	1	2	3
Few other trout areas in Arizona	1	2	3

Other ______________________________

3) How many fish did you, personally, keep today? ______FISH

What was the biggest fish you kept? ______lbs.

4) What do you consider to be a "trophy size" rainbow trout? ______lbs.

5) Counting this year, how many years have you been fishing at Lee's Ferry? ______YEARS

6) How many days have you fished at Lee's Ferry in 1984? ______DAYS

7) Have you camped upstream along the river during 1984?

1 NO
2 YES---→How many nights? _______

8) On average, how crowded did you feel the river was when you were fishing today? (CIRCLE THE NUMBER BEST REPRESENTING YOUR FEELINGS)

1	2	3	4	5	6	7	8	9
Not at all Crowded		Slightly Crowded		Moderately Crowded			Extremely Crowded	

9) How important would each of the following be in contributing to an excellent or perfect fishing trip at Lee's Ferry for you? (CIRCLE ONE NUMBER FOR EACH ITEM)

	Not Important	Somewhat Important	Very Important
Catching a trophy fish	1	2	3
Catching your limit	1	2	3
Good Weather	1	2	3
High water level	1	2	3
Low water level	1	2	3
Camping along the river	1	2	3
Seeing few others	1	2	3
Rising water level during the day	1	2	3
Falling water level during the day	1	2	3

Other ______________________________

10) How important would each of the following be in contributing to a poor fishing trip at Lee's Ferry for you

	Not Important	Somewhat Important	Very Important
Not catching your limit	1	2	3
Not catching a trophy fish	1	2	3
Catching no fish	1	2	3
Poor weather	1	2	3
High water level	1	2	3
Low water level	1	2	3
Rising water level	1	2	3
Falling water level	1	2	3
Seeing many others	1	2	3
Not being able to get upstream to fish	1	2	3
Boat/Motor trouble due to the water level	1	2	3
Not being able to camp along the river	1	2	3

Other ______________________________

11) Have you ever fished at Lee's Ferry under the following conditions?

	Yes	No	Don't Know
Medium water (9,000-16,000 CFS)	1	2	3
Low water (9,000 CFS or less)	1	2	3
Fluctuating water levels	1	2	3

12) Did you know today's expected water level before your trip?

1 NO, DIDN'T TRY TO FIND OUT
2 NO, TRIED TO FIND OUT BUT COULDN'T
3 YES---→What was your source of information?

____

13) How would a lower water level affect each of the following?

	No Effect	Decrease	Increase	Don't Know
My chances of catching fish	1	2	3	4
My chances of catching a trophy fish	1	2	3	4
Amount of time spent fishing	1	2	3	4
My chances to fish certain areas I like	1	2	3	4
Problems with boat/motor	1	2	3	4

Other ______________________________

14) Did you go all the way upstream (as far as you were allowed) today?

1 YES
2 NO---→Why not? ______________

____

15) What is your zip code? ____________

16) Please circle the response that comes closest to your total family income before taxes. (CIRCLE ONE NUMBER)

1 LESS THAN $10,000
2 $10,000 - $24,999
3 $25,000 - $39,999
4 $40,000 - $59,999
5 $60,000 - $79,999
6 $80,000 OR MORE

APPENDIX G

GLEN CANYON ANGLERS ON-SITE PRE-CONTINGENT-VALUATION SURVEY

1985 LEE'S FERRY ANGLERS SURVEY

This survey asks you several questions about your current fishing trip. In answering these questions, please assume that this current trip began when you left home to come to Lee's Ferry to fish.

---

1. How many days have you been fishing at Lee's Ferry on this current trip, so far?

    _____ days, so far

2. Overall, how would you rate your fishing trip so far? (CIRCLE ONE NUMBER)

    1 POOR
    2 FAIR, it just hasn't worked out very well
    3 GOOD, but a number of things could have been different
    4 VERY GOOD, but could have been better
    5 EXCELLENT, only minor problems
    6 PERFECT

3. Compared to your expectations, how has the fishing been so far? (CIRCLE ONE NUMBER)

    1 MUCH WORSE THAN I EXPECTED
    2 SOMEWHAT WORSE THAN I EXPECTED
    3 ABOUT WHAT I EXPECTED
    4 SOMEWHAT BETTER THAN I EXPECTED
    5 MUCH BETTER THAN I EXPECTED

4. On average, how crowded did you feel on the river while you were fishing? (CIRCLE THE NUMBER BEST REPRESENTING YOUR FEELINGS)

1	2	3	4	5	6	7	8	9
Not at all Crowded		Slightly Crowded		Moderately Crowded			Extremely Crowded	

5. Have you, personally, caught any fish on this trip so far? (CIRCLE ONE)

    1 NO
    2 YES------>How many fish did you catch? _____ fish
    ------>What was the largest fish you caught?
    ______lbs ______ inches

6. Have you kept any fish that you personally caught on this trip so far? (CIRCLE ONE)

    1 NO
    2 YES------>How many fish have you kept? _____ fish
    ------>What is the largest fish you kept?
    ______lbs ______ inches

7. How would you rate the water conditions today? (CIRCLE ONE)

    1 WATER WAS TOO HIGH
    2 WATER WAS ABOUT RIGHT
    3 WATER WAS TOO LOW

Name ________________________________

Address ______________________________

City __________________ State ___________ Zip ______

Telephone (____) ______________

APPENDIX H

GLEN CANYON ANGLERS CONTINGENT-VALUATION SURVEY

Earlier this year, on ______________, you filled out a short survey when you were fishing at Lee's Ferry. When answering questions in this survey, we would like you to think about that trip. On that particular trip you had already caught _____ fish (which included any fish you may have caught and released). The largest fish you had caught was about ____ lbs. and was ____ inches long.

We would like you to recall the trip when you filled out the short questionnaire at Lee's Ferry. How did that trip turn out for you?

A1. Overall, how would you rate the fishing on that trip? (CIRCLE ONE NUMBER)

1 POOR

2 FAIR, IT JUST DIDN'T WORK OUT WELL

3 GOOD, BUT I WISH A NUMBER OF THINGS COULD HAVE BEEN DIFFERENT

4 VERY GOOD, BUT COULD HAVE BEEN BETTER

5 EXCELLENT, ONLY MINOR PROBLEMS

6 PERFECT

A2. On that trip, what was your main method of fishing? (CIRCLE ONE NUMBER)

1 FROM A BOAT

2 FROM THE BANK

A3. How many days, in total, did you spend fishing at Lee's Ferry during the trip when you filled out the short survey?

_____ TOTAL DAYS OF FISHING ON THAT TRIP

A4. How many fish did <u>you</u>, personally, catch on that trip? (Include those you reported the day you filled out our survey at Lee's Ferry, as well as any fish you may have released.)

_____ FISH

A5. What was the biggest fish <u>you</u>, personally, caught on that trip? (Give your best estimate).

_____ LBS. ______ INCHES

A6. How many fish did <u>you</u>, personally, keep on that trip?

_____ FISH

A7. How would you best describe your reason(s) for taking the trip you were on when you filled out our survey at Lee's Ferry? (CIRCLE ONE NUMBER)

1 FISHING AT LEE'S FERRY WAS THE ONLY REASON FOR THE TRIP

2 FISHING AT LEE'S FERRY WAS THE MOST IMPORTANT REASON FOR THE TRIP

3 FISHING AT LEE'S FERRY WAS ONE OF SEVERAL EQUALLY IMPORTANT REASONS FOR MAKING THAT TRIP

4 FISHING AT LEE'S FERRY WAS NOT AN IMPORTANT REASON FOR MAKING THAT TRIP

A8. How would you describe the destinations of the trip you were on when you filled out our survey at Lee's Ferry? (CIRCLE ONE NUMBER)

1 LEE'S FERRY WAS THE SOLE DESTINATION OF THAT TRIP

2 LEE'S FERRY WAS THE MOST IMPORTANT DESTINATION OF THAT TRIP

3 LEE'S FERRY WAS ONLY ONE OF SEVERAL EQUALLY IMPORTANT DESTINATIONS ON THAT TRIP

4 LEE'S FERRY WAS JUST AN INCIDENTAL STOP ON THE WAY TO SOME OTHER DESTINATION

A9. Was any part of your trip to Lee's Ferry by airplane?

1 YES---->Skip to Question 14, next page

2 NO

A10. About how long did it take you to travel from your home to Lee's Ferry?

______ DAY(S) _______ TOTAL HOURS OF DRIVING

A11. What type of vehicle did you use to get to Lee's Ferry? (CIRCLE ONE NUMBER)

1 FULL SIZED AUTOMOBILE

2 INTERMEDIATE SIZED AUTOMOBILE

3 COMPACT AUTOMOBILE

4 SMALL TRUCK (Toyota, Nissan, Courier, etc.)

5 R.V., FULL SIZE TRUCK, VAN

A12. Were you pulling a boat or trailer?

1 YES

2 NO

A13. How many people travelled with you (in the same vehicle) to Lee's Ferry?

MYSELF AND _____ OTHER PEOPLE

A14. As near as you can recall for the trip when you filled out our short survey, about how much was your share of total trip expenses for the following items? (Include only money you personally spent. If you didn't spend money on a certain item, please put $0). [PLEASE CALCULATE AND FILL IN THE TOTAL ON THE LAST LINE].

Gas and Oil for vehicle	$__________
Food and Beverages	$__________
Lodging, Camping	$__________
Fishing equipment/bait/license	$__________
Guide fees	$__________
Boat/equipment rental	$__________
Airfare	$__________
Car rental	$__________
Other ________________________	$__________
TOTAL YOU SPENT ON THIS TRIP	$________

A15. Would you still have gone on that particular trip to Lee's Ferry if your expenses had been $______ **more** than the total you just calculated? (CIRCLE ONE NUMBER)

1 YES, the trip would still be worthwhile

2 NO, it would not be worthwhile

PLEASE READ CAREFULLY

River flows at Lee's Ferry are affected by the operation of Glen Canyon Dam. River flows, in turn, may have an impact on the quality of a fishing trip at Lee's Ferry in many ways. Fish might be easier or harder to catch, access along the banks may be better or worse, or boats may be easier or harder to handle.

In the next series of questions we will describe several types of river conditions at Lee's Ferry. For each condition, we have described the potential effects on fishing. Our description of these effects are based on previous studies of fishing at Lee's Ferry. They are included to help you evaluate the fishing under the various conditions. Since these descriptions are based on the general opinions of Lee's Ferry anglers, your own personal opinions about the effects may differ. For each type of condition, we would like you to tell us how the river flow would have affected the quality of the fishing trip you were on when you filled out the short survey. Records from Glen Canyon Dam show that the average water flow <u>that day</u> was __________ cubic feet per second (cfs), with a high flow of ________ cfs and a low flow of __________ cfs.

To help put these numbers in perspective, bank and boat anglers sometimes have difficulty fishing at high water levels (over 25,000 cfs) because of the swift current. In addition, some anglers may experience trouble in handling their boats in flows above 25,000 cfs. In the past, the National Park Service has imposed a 25 horsepower requirement on motors when flows have exceeded 40,000 cfs. On the other end of the scale, low water levels (below 9,000 cfs) may tend to concentrate the fish. While low water levels may make access easier for bank anglers, boat anglers start experiencing more damage to boats and motors. In addition, it is known that very few boat anglers can pass over the sand and gravel bar three miles upstream from Lee's Ferry when the flow is less than 3,000 cfs.

CASE 1

Boat anglers have said that getting upstream to fish can sometimes be a problem at low water (3,000 cfs or less). At a constant flow of 3,000 cfs, large boats can't get past the sand and gravel bar three miles upstream from Lee's Ferry, while even very small boats may have to be dragged over slippery rock gravel bars. Consequently, nearly all of the fishing would occur in the three miles just above Lee's Ferry. In addition, damage to boats and motors is somewhat more frequent than at higher water levels. However, low water tends to concentrate fish, and bank anglers can find large areas of exposed gravel and rocks leaving a great deal of space between the water and the edge of the vegetation.

B1. Do you think a fishing trip under the conditions described above (water level constant at 3,000 cfs) would be better or worse than the trip you took when you filled out our short survey at Lee's Ferry? (CIRCLE ONE NUMBER)

1 BETTER

2 WORSE

3 ABOUT THE SAME

B2. If the river conditions were always like those described above for Case 1 (constant flows of 3,000 cfs), would it affect the number of times you would go to Lee's Ferry to fish in a typical year?

1 YES----->How so? (CIRCLE ONE NUMBER)

1 I would make FEWER trips per year--How many?

_____ FEWER TRIPS PER YEAR

2 I would make MORE trips per year--How many?

_____ MORE TRIPS PER YEAR

2 NO, IT WOULDN'T AFFECT HOW OFTEN I COME TO LEE'S FERRY TO FISH

We would like you to imagine that you are deciding whether or not to take a trip to Lee's Ferry. The conditions (weather, number of anglers coming to Lee's Ferry, etc.) on this trip would be the same as when you filled out our survey with two exceptions:

The water level would be constant at 3,000 cfs (see Case 1)

AND

Your expenses increased by $_____ (over the total expenses you calculated on page 3)

B3. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

CASE 2

The questions above asked about a relatively constant flow of 3,000 cfs. Daily **changes** in the water flow may have other effects, in addition to those described in Case 1, on the quality of fishing. With flows changing daily from a low of 1,000 cfs to a high flow of 15,000 cfs (around an average flow of 3,000 cfs), boats may get swamped if they are tied too tightly to the bank during a fluctuation. There is also a chance of getting stranded above 3 mile bar if the water drops substantially. On the other hand, biological studies give some indication that rising water may cause the fishing to improve as fish begin to feed on the debris stirred up by the rising water.

B4. How do you think the fishing experience would be if there were large daily fluctuations (with the conditions described in Case 2 above) around a base of 3,000 cfs as opposed to being constant at 3,000 cfs? (CIRCLE ONE NUMBER)

1 I THINK IT WOULD MAKE NO DIFFERENCE

2 THE FLUCTUATIONS WOULD HURT THE FISHING EXPERIENCE

3 THE FLUCTUATIONS WOULD IMPROVE THE FISHING EXPERIENCE

B5. If the river conditions were always like those described above for Case 2 (daily changes around an average flow of 3,000 cfs), would it affect the number of times you would go to Lee's Ferry to fish in a typical year?

1 YES----->How so? (CIRCLE ONE NUMBER)

1 I would make FEWER trips per year--How many?

_____ FEWER TRIPS PER YEAR

2 I would make MORE trips per year--How many?

_____ MORE TRIPS PER YEAR

2 NO, IT WOULDN'T AFFECT HOW OFTEN I COME TO LEE'S FERRY TO FISH

Now we would like you to imagine that you are deciding whether or not to take a fishing trip to Lee's Ferry. The conditions (weather, number of anglers on the river, etc.) on this trip would be the same as the trip when you filled out our survey with <u>two exceptions</u>:

There would be large daily fluctuations from a low flow of 1,000 cfs to a high flow of 15,000 cfs around an average flow of 3,000 cfs (see descriptions for Case 2 above).

AND

Your expenses increased by $_______ (over the total you calculated on page 3)

B6. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

CASE 3

Boat anglers seem to experience fewer problems with damage to their boats and motors when the water is at least 10,000 cfs, and boats can get up and downstream with no difficulty. At a flow of 10,000 cfs, bank anglers would still find exposed gravel and rock bars and some room between the water's edge and shore vegetation. In previous studies, about 40 percent of the anglers have said that they feel the fishing is generally better at constant flows of 10,000 cfs than when the water level is higher.

C1. Do you think a fishing trip under the conditions described above for Case 3 (constant flow of 10,000 cfs) would be better or worse than the trip when you filled out our short survey at Lee's Ferry? (CIRCLE ONE NUMBER)

1 BETTER

2 WORSE

3 ABOUT THE SAME

C2. If the river conditions were always like those described above in Case 3 (constant at 10,000 cfs), would it affect the number of times you would go to Lee's Ferry to fish in a typical year?

1 YES----->How so? (CIRCLE ONE NUMBER)

1 I would make FEWER trips per year--How many?

_____ FEWER TRIPS PER YEAR

2 I would make MORE trips per year--How many?

_____ MORE TRIPS PER YEAR

2 NO, IT WOULDN'T AFFECT HOW OFTEN I COME TO LEE'S FERRY TO FISH

We would like you to imagine you are deciding whether or not to take a trip to Lee's Ferry. The conditions (weather, number of anglers coming to Lee's Ferry, etc.) on this trip would be exactly the same as the trip when you filled out our short survey with two exceptions:

The water flow would be constant at 10,000 cfs (as described in Case 3 above)

AND

Your travel expenses increased by $ _____ (over the total expenses you calculated on page 3).

C3. Would you make this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

CASE 4

The questions above asked about a relatively constant flow of 10,000 cfs. Daily **changes** in the flow may have other effects on the quality of fishing in addition to those described above for Case 3. At moderate flows, large daily fluctuations from a low flow of 1,000 cfs to a high flow of 22,000 cfs (around an average of 10,000 cfs) may contribute to the swamping of boats tied to the bank or dragging anchors. There would still be a chance of getting stranded above 3 mile bar. Again, however, there is some indication that the rising water may improve fishing as fish begin to feed on debris stirred up by the rising water.

C4. How do you think the fishing experience would be if there were large daily fluctuations (with the conditions described in Case 4) around a base of 10,000 cfs as opposed to being constant at 10,000 cfs? (CIRCLE ONE NUMBER)

1 I THINK IT WOULD MAKE NO DIFFERENCE

2 THE FLUCTUATIONS WOULD HURT THE FISHING EXPERIENCE

3 THE FLUCTUATIONS WOULD IMPROVE THE FISHING EXPERIENCE

C5. If the river conditions were always like those described above for Case 4 (daily changes around an average flow of 10,000 cfs), would it affect the number of times you would go to Lee's Ferry to fish in a typical year?

1 YES----->How so? (CIRCLE ONE NUMBER)

1 I would make FEWER trips per year--How many?

______FEWER TRIPS PER YEAR

2 I would make MORE trips per year--How many?

______MORE TRIPS PER YEAR

2 NO, IT WOULDN'T AFFECT HOW OFTEN I COME TO LEE'S FERRY TO FISH

Now we would like you to imagine that you are deciding whether or not to take a fishing trip to Lee's Ferry. The conditions (weather, number of anglers on the river, etc.) on this trip would be the same as the trip when you filled out our survey with <u>two exceptions</u>:

There would be large daily fluctuations from a low flow of 1,000 cfs to a high flow of 22,000 cfs around an average flow of 10,000 cfs (see Case 4 above).

AND

Your expenses were increased by $______ (over the total you calculated on page 3)

C6. Would you make this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

CASE 5

Next, consider a constant flow of 25,000 cfs. There is no minimum motor horsepower restriction, although motors with 10 hp or less may have problems getting upstream. The chance of damage to boats and motors due to obstructions in the water are small, but the high flows of 25,000 cfs may increase the chances of swamping a boat while dragging an anchor, especially for inexperienced boaters.

Fish may be less concentrated at this higher flow level. Bank anglers may have less space between the waters edge and bank vegetation, but eddies along the shoreline are often larger and more pronounced. About 12 percent of the anglers in a recent survey felt that fishing was better at 25,000 cfs than at lower water levels in Glen Canyon.

D1. Do you think a fishing trip under the conditions described for Case 5 above (constant flow of 25,000 cfs) would be better or worse than the trip when you filled out our short survey at Lee's Ferry?

1 BETTER

2 WORSE

3 ABOUT THE SAME

D2. If the river conditions were always like those described above in Case 5 (constant at 25,000 cfs), would it affect the number of times you would go to Lee's Ferry to fish in a typical year? (CIRCLE ONE NUMBER)

1 YES----->How so? (CIRCLE ONE NUMBER)

1 I would make FEWER trips per year--How many?

_____ FEWER TRIPS PER YEAR

2 I would make MORE trips per year--How many?

_____ MORE TRIPS PER YEAR

2 NO, IT WOULDN'T AFFECT HOW OFTEN I COME TO LEE'S FERRY TO FISH

We would like you to imagine you are deciding whether or not to take a trip to Lee's Ferry. The conditions (weather, number of anglers coming to Lee's Ferry, etc.) on this trip would be exactly the same as the trip when you filled out our short survey with <u>two exceptions</u>:

The water flow would be constant at 25,000 cfs (see Case 5 above)

AND

Your expenses increased by $ _____ (over the total expenses you calculated on page 3).

D3. Would you make this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

CASE 6

The impacts of large daily fluctuations are somewhat different at higher water than at lower water levels. With fluctuations from low flows of 12,000 cfs to high flows of 32,000 cfs (around an average flow of 25,000 cfs), it is very unlikely boats would get stranded above 3 mile bar. Boats tied too tightly to the shoreline, however, may be flooded. Rising water might also trigger more feeding by fish, but fish become more difficult to find because of the higher water and faster current. In the long run, large daily fluctuations at this flow level may wash away many of the campsites upstream from Lee's Ferry.

D4. How do you think the fishing experience would be if there were large daily fluctuations (with the conditions described in Case 6) around an average flow of 25,000 cfs as opposed to being constant at 25,000 cfs? (CIRCLE ONE NUMBER)

1 I THINK IT WOULD MAKE NO DIFFERENCE

2 THE FLUCTUATIONS WOULD HURT THE FISHING EXPERIENCE

3 THE FLUCTUATIONS WOULD IMPROVE THE FISHING EXPERIENCE

D5. If the river conditions were always like those described above for Case 6 (daily changes around an average flow of 25,000 cfs), would it affect the number of times you would go to Lee's Ferry to fish in a typical year?

1 YES----->How so? (CIRCLE ONE NUMBER)

  1 I would make FEWER trips per year--How many?

  _____ FEWER TRIPS PER YEAR

  2 I would make MORE trips per year--How many?

  _____ MORE TRIPS PER YEAR

2 NO, IT WOULDN'T AFFECT HOW OFTEN I COME TO LEE'S FERRY TO FISH

Now we would like you to imagine that you are deciding whether or not to take a fishing trip to Lee's Ferry. The conditions (weather, number of anglers coming to Lee's Ferry, etc.) on this trip would be the same as the trip when you filled out our survey with <u>two exceptions</u>:

There would be large daily fluctuations from a low flow of 12,000 cfs to a high flow of 32,000 cfs around an average flow of 25,000 cfs (see Case 6).

AND

Your expenses increased by $_______ (over the total you calculated on page 3)

D6. Would you make this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

CASE 7

At constant flows of 40,000 cfs, the current is swift and the Park Service requires all boat motors to have at least a 25 horsepower motor. Large boats can get up and down the river more easily than smaller boats. The chances of damage to boats and motors due to obstructions in the water are smaller than at lower flows. However, for inexperienced boaters the high water increases the chances of boats being swamped while dragging anchors. Eddies along the shoreline are larger and well defined, but bank anglers find the water is up into the bank vegetation and this may make bank fishing more difficult for them. At these high flows, fish feeding patterns may change since fish would generally stay out of the main current. Fish may be harder to find.

E1. Do you think a fishing trip under the conditions described above for Case 7 (constant flow of 40,000 cfs) would be better or worse than the trip when you filled out our short survey at Lee's Ferry?

1 BETTER

2 WORSE

3 ABOUT THE SAME

E2. If the river conditions were always like those described above in Case 7 (constant at 40,000 cfs), would it affect the number of times you would go to Lee's Ferry to fish in a typical year? (CIRCLE ONE NUMBER)

1 YES----->How so? (CIRCLE ONE NUMBER)

1 I would make FEWER trips per year--How many?

_____ FEWER TRIPS PER YEAR

2 I would make MORE trips per year--How many?

_____ MORE TRIPS PER YEAR

2 NO, IT WOULDN'T AFFECT HOW OFTEN I COME TO LEE'S FERRY TO FISH

We would like you to imagine you are deciding whether or not to take a trip to Lee's Ferry. The conditions (weather, number of anglers coming to Lee's Ferry, etc.) on this trip would be exactly the same as the trip when you filled out our short survey with two exceptions:

The water flow would be constant at 40,000 cfs (see Case 7 above)

AND

Your expenses increased by $ _____ (over the total expenses you calculated on page 3).

E3. Would you make this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

In addition to short term effects on fishing success, access to the river, and ease of boat handling, river flows may have longer term impacts on the size and number of fish in the river around Lee's Ferry.

These last two cases describe two possible changes in fishing success. After reading the description of each change, we would like you to tell us how that change would affect the quality of your fishing trip(s) at Lee's Ferry.

CHANGE 1

A survey of anglers at Lee's Ferry last year showed that about 15 percent of them reported catching a fish larger than three pounds, and only 3 percent reported catching a fish larger than four pounds. These numbers reflect how an average angler might do on any particular day at Lee's Ferry. We realize that no one is exactly average, but we would like you to suppose that the fishery at Lee's Ferry changed in such a way that your chances of catching one of these bigger fish were to double. If you feel you are an average fisher, your chances of catching a fish bigger than three lbs. would now be about 30 percent, while your chances of catching a fish bigger than four lbs. would now be about 6 percent. If you think you are not an average fisherman at Lee's Ferry, your chances would vary accordingly.

F1. If the fishery changed in this way (so that your chances of catching a fish bigger than three pounds had doubled) would it affect the number of times you would travel to Lee' Ferry to fish, in an average year? (CIRCLE ONE NUMBER)

1 YES----->How so? (CIRCLE ONE NUMBER)

1 I would make FEWER trips per year--How many?

_____ FEWER TRIPS PER YEAR

2 I would make MORE trips per year--How many?

_____ MORE TRIPS PER YEAR

2 NO, IT WOULDN'T AFFECT HOW OFTEN I COME TO LEE'S FERRY TO FISH

Now we would like you to imagine you are deciding whether or not to take a trip to Lee's Ferry. On this trip all of the fishing conditions (water levels, weather, number of other anglers coming to Lee's Ferry, etc.) would be the same as the trip when you filled out our survey with two exceptions:

Your chances of catching a big fish (over 3 pounds) would be doubled

AND

Your expenses of a trip to Lee's Ferry increased by $ _____ (over the total you calculated on page 3)

F2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

CHANGE 2

We are sure that almost every angler has experienced, at one time or another, "getting skunked" (catching no fish at all). In fact, about 20 percent of our respondents to a previous survey at Lee's Ferry reported they had not yet caught a fish. This number reflects how an average angler might do on any particular day at Lee's Ferry. No one is exactly average, but we would like you to suppose that the fishery at Lee's Ferry changed in such a way that <u>your</u> chances of getting skunked were to double. In other words, if you feel you are an average angler and came repeatedly to Lee's Ferry, you could expect that on four out of ten trips you would catch no fish at all. If you were an above average angler, your chances of getting skunked would be less, and if you were below average, the chances would be greater than 4 out of 10 times.

G1. If the fishery changed in this way (so that your chances of catching no fish doubled) would it affect the number of times you would travel to Lee's Ferry to fish in an average year? (CIRCLE ONE NUMBER)

1 YES----->How so? (CIRCLE ONE NUMBER)

1 I would make FEWER trips per year--How many?

_____ FEWER TRIPS PER YEAR

2 I would make MORE trips per year--How many?

_____ MORE TRIPS PER YEAR

2 NO, IT WOULDN'T AFFECT HOW OFTEN I COME TO LEE'S FERRY TO FISH

Now we would like you to imagine that you are deciding whether or not to make a trip to Lee's Ferry. On this trip, all of the fishing conditions (water levels, weather, number of other anglers coming to Lee's Ferry, etc.) would be the same as the trip when you filled out our survey, with <u>two exceptions</u>:

Your chances of catching no fish would double

AND

Your expenses increased by $ _____ (over the total expenses you calculated on page 3)

G2. Would you go on this trip? (CIRCLE ONE NUMBER)

1 YES, it would still be worthwhile

2 NO, it would not be worthwhile

In the previous sections there were a number of questions where we asked whether you would still make the trip to Lee's Ferry to fish if your expenses increased by a certain amount.

To help us better understand your responses, we would like to know the extent to which various factors affected your answers to the expense questions. Please tell us whether the following statements were true or not for you when answering the previous questions (CIRCLE ONE RESPONSE FOR EACH STATEMENT).

	Definitely True	Probably True	Probably False	Definitely False
My main concern was that license fees may be increased for fishing at Lee's Ferry.	1	2	3	4
My responses reflected my best guess as to whether the described trip would have been worthwhile.	1	2	3	4
I just don't want to have to pay more to fish at Lee's Ferry, regardless of the conditions.	1	2	3	4
My responses reflected the fact that I don't think dollar values should be put on the fishing experience at Lee's Ferry.	1	2	3	4

Are there any other factors that affected your answers? (please describe: ______________________

______________________________________)

In this section we would like to find out about your fishing background.

I1. Was 1985 your first year of fishing at Lee's Ferry? (CIRCLE ONE)

1 YES

2 NO----->Including this year, how many years have you fished at Lee's Ferry?

_____ YEARS

----->About how many trips do you make to Lee's Ferry in an average year?

_____ TRIPS

I2. Was the fishing trip when you filled out our short survey the only trip you have made to Lee's Ferry in the last 12 months? (CIRCLE ONE)

1 YES

2 NO----->Including the trip when you filled out our short survey, how many trips have you made in the last 12 months?

_____ TRIPS

----->What is the average number of days you spend at Lee's Ferry on a typical fishing trip there?

_____ DAYS

I3. Some people have many other activities which they enjoy as much as fishing at Lee's Ferry. Others have very few. Which of the following statements most closely reflects how you feel? (CIRCLE ONE)

1 If I couldn't go fishing at Lee's Ferry I probably would not miss it at all and would find something else that was just as enjoyable

2 If I couldn't go fishing at Lee's Ferry, I would miss it, but not as much as a lot of other things I now enjoy

3 If I couldn't go fishing at Lee's Ferry, I would miss it more than most of the other interests I now enjoy

4 If I couldn't go fishing at Lee's Ferry, I would miss it more than all of the other interests I now enjoy

In this final section, we would like to ask some questions about your background and occupation which will help us compare your answers with those of other people. We stress that all of your answers are strictly confidential.

J1. How old are you? ______ YEARS OLD

J2. Are you:

1 MALE

2 FEMALE

J3. How many years of school have you completed? (CIRCLE OR CHECK THE HIGHEST YEAR OR LEVEL)

1 2 3 4 5 6 7 8 9 10 11 12

___ Some college ___ M.A., M.S.

___ B.A. or equivalent ___ Advanced degree (M.D., Ph.D)

J4. Please circle the response that comes closest to your total family income before taxes. (CIRCLE ONE NUMBER)

1 Less than $10,000

2 $10,000 to $19,999

3 $20,000 to $29,999

4 $30,000 to $39,999

5 $40,000 to $49,999

6 $50,000 to $59,999

7 $60,000 to $69,999

8 $70,000 to $79,999

9 $80,000 to $89,999

10 $90,000 to $99,999

11 $100,000 or more

J5. With reference to your primary occupation, are you currently (CIRCLE ONE NUMBER):

1 EMPLOYED FULL-TIME

2 EMPLOYED PART-TIME

3 FULL-TIME HOMEMAKER

4 TEMPORARILY UNEMPLOYED

5 NOT EMPLOYED AND NOT LOOKING FOR WORK

6 RETIRED, NOT WORKING

7 RETIRED, WORKING PART-TIME

APPENDIX I

DAY-USE RAFTERS ATTRIBUTE SURVEY

****
In this section, we would like to find out about your reasons for taking this raft trip and how you enjoyed it.
****

1. Do you live in Northern Arizona?

   1 NO

   2 YES---->Skip to Question 6

2. What was the <u>main</u> reason you came to Northern Arizona?

   ____

3. How many days did you stay in Northern Arizona?

   _____ day(s)

4. Were you aware of the one-day Glen Canyon raft trip <u>before</u> you came to Northern Arizona? (CIRCLE ONE NUMBER)

   1 NO---->Where did you learn about it? (CIRCLE ONE NUMBER)

      1 IN THE PAGE AREA

      2 AT THE SOUTH RIM OF THE GRAND CANYON

      3 OTHER ______________________________

      ____

   2 YES---->How did you learn about the raft trip? (CIRCLE ONE NUMBER)

      1 AD IN TRAVEL MAGAZINE

      2 FROM OTHERS WHO HAD TAKEN THE TRIP

      3 RAFT TRIP COMPANY BROCHURE

      4 WROTE TO GRAND CANYON NATIONAL PARK

      5 OTHER ______________________________

      ____

5. Was the chance to go on this one-day raft trip an important reason to you in deciding to come to the Northern Arizona? (CIRCLE ONE NUMBER)

   1 NOT AT ALL IMPORTANT REASON

   2 SOMEWHAT IMPORTANT REASON

   3 VERY IMPORTANT REASON

   4 I WASN'T AWARE OF THE ONE-DAY RAFT TRIP WHEN I DECIDED

6. If you had the opportunity, would you take this raft trip again? (CIRCLE ONE NUMBER)

   1 DEFINITELY NOT

   2 PROBABLY NOT

   3 PROBABLY YES

   4 DEFINITELY YES

7. Overall, how would you rate your raft trip? (CIRCLE ONE NUMBER)

   1 POOR

   2 FAIR, it just didn't work out very well

   3 GOOD, but a number of things could have been different

   4 VERY GOOD, but could have been better

   5 EXCELLENT, only minor problems

   6 PERFECT

8. What was your <u>main</u> reason for taking the Glen Canyon <u>raft trip</u>? PLEASE TRY TO BE AS SPECIFIC AS YOU CAN.

____

____

9. What things would contribute most to an <u>excellent or perfect</u> one-day raft trip in the Glen Canyon area <u>for you</u>?

____

____

____

10. What things would contribute most to a <u>poor</u> one-day raft trip in the Glen Canyon area <u>for you</u>?

____

____

____

11. Including yourself, about how many people were there on this raft trip? (INCLUDE YOUR GUIDE OR TRIP LEADER AND ALL OF THE RAFTS THAT WERE WITH YOUR RAFT.)

    ______PEOPLE

12. Would you have liked a tour of the Glen Canyon Dam as part of your raft trip? (CIRCLE ONE NUMBER)

    1 NO

    2 YES---->How do you think this would have improved your raft trip experience?

    ____

    ____

    ____

    ____

13. How many <u>white water</u> raft or kayak trips have you taken? Do not include the one-day raft trip in Glen Canyon. (CIRCLE ONE NUMBER)

1 NONE

2 1-2

3 3-5

4 6-10

5 11-20

6 MORE THAN 20

14. Do you think the Glen Canyon river trip is a good substitute for a river trip through the Grand Canyon? (CIRCLE ONE NUMBER)

1 NO

2 YES

15. Raft trips through the Glen Canyon area have a number of features and people differ in what they feel is important to them personally. In this next section, we list a number of features of a Glen Canyon raft trip. Please indicate how important each feature was for you on your trip. (CIRCLE ONE NUMBER FOR EACH ITEM)

	Not at all Important	Somewhat Important	Very Important	Did not Experience
Being in a natural setting	1	2	3	0
Seeing wildlife	1	2	3	0
Being able to say I've been to the Glen Canyon	1	2	3	0
Being with family or friends	1	2	3	0
Interacting with my guide or trip leader	1	2	3	0
Learning about the history of Glen Canyon	1	2	3	0
Relaxing; getting away from it all	1	2	3	0
Stopping for lunch along the river	1	2	3	0
Well paced and organized trip	1	2	3	0
Starting the trip at the dam	1	2	3	0
Good weather	1	2	3	0
Stopping to explore along the river	1	2	3	0
Seeing few others while on the river	1	2	3	0
Learning about others on the trip	1	2	3	0

	Not at all Important	Somewhat Important	Very Important	Did not Experience
Feeling safe	1	2	3	0
Having confidence in my guide or trip leader	1	2	3	0
Not having to make advance plans for the river trip	1	2	3	0
Seeing the Canyon in one day	1	2	3	0
Seeing archeological sites in the Canyon	1	2	3	0
Floating without the motor on a quiet stretch of the river	1	2	3	0
Learning about the Glen Canyon Dam	1	2	3	0
Being on the Colorado River	1	2	3	0
Other ____________________ ____________________	1	2	3	0

16. On average, how crowded did you feel the river was when you were rafting on this trip? (Circle the number on the scale which best represents your feelings.)

1	2	3	4	5	6	7	8	9
Not at all Crowded		Slightly Crowded		Moderately Crowded			Extremely Crowded	

****
These next questions are about the water level on the river the day you took your trip.
****

1. When you signed up for this trip, did you know the expected water level on the Colorado river for the date of your trip?

   1 NO

   2 YES----->Did this information about the expected water level have any influence on your decision WHEN to take this trip?

      1 NO

      2 YES (please explain) ____________

      ____

      ____

2. Did you notice the water level changing during your raft trip?

   1 NO

   2 YES

3. Was the speed of the water (the current) during your raft trip: (CIRCLE ONE NUMBER)

   1 TOO SLOW

   2 ABOUT RIGHT

   3 TOO FAST

   4 DON'T KNOW

4. If you had your choice, would you have preferred the water level be: (CIRCLE ONE NUMBER)

   1 LOWER

   2 ABOUT THE SAME

   3 HIGHER

   4 DON'T KNOW OR DOESN'T MATTER

5. What a guide or trip leader does and says during a trip can also affect a person's trip. During your trip, how often did your guide or trip leader do the following: (CIRCLE ONE NUMBER FOR EACH ITEM)

	Never	Sometimes	Often	Didn't Notice
Turned the motor on to make time	1	2	3	0
Manuevered the raft around rocks	1	2	3	0
Commented that the water level was too low	1	2	3	0
Commented that the water level was too high	1	2	3	0
Commented that the current was too fast	1	2	3	0
Commented that the current was too slow	1	2	3	0
Shut motor off to talk about the River/Canyon	1	2	3	0
Shut off the motor because of low water or rocks	1	2	3	0
Pointed out archeological or other attractions	1	2	3	0

Other ______________________________

6. Did your guide or trip leader discuss how the Glen Canyon Dam affected your trip?

1 NO

2 YES---->What did he/she say? ______________________

____

____

****
In this last section we would like to ask you some questions about your background which will help us compare your answers to those of other people. We would stress that <u>all</u> of your answers are <u>strictly confidential</u>.
****

1. How old are you? _____years old

2. Are you: 1 MALE

   2 FEMALE

3. How many years of school have you completed? (CIRCLE OR CHECK THE CORRECT RESPONSE)

   1 2 3 4 5 6 7 8 9 10 11 12

   ___some college or technical school

   ___B.A. or equivalent

   ___M.A. or equivalent

   ___Advanced degree (M.D. Ph.D., etc.)

4. Please circle the response that comes closest to your total <u>family</u> income before taxes. <u>If you are a student and unmarried</u>, please give your parents' income. (CIRCLE ONE NUMBER)

1	Less than $10,000	7	$50,000 to $59,999
2	$10,000 to $17,499	8	$60,000 to $69,999
3	$17,500 to $24,999	9	$70,000 to $79,999
4	$25,000 to $32,499	10	$80,000 to $89,999
5	$32,500 to $39,999	11	$90,000 to $99,999
6	$40,000 to $49,999	12	$100,000 or more

THANK YOU FOR YOUR HELP!

If you would like a copy of the results, please check here: ________

APPENDIX J

DAY-USE RAFTERS CONTINGENT-VALUATION SURVEY

In this first section, we would like to find out about your raft trip in Glen Canyon and how much you enjoyed it.

---

1. Overall, how would you rate your raft trip? (CIRCLE ONE NUMBER)

   1 POOR

   2 FAIR, it just didn't work out very well

   3 GOOD, but a number of things could have been different

   4 VERY GOOD, but could have been better

   5 EXCELLENT, only minor problems

   6 PERFECT

2. If you had the opportunity, would you take this raft trip again? (CIRCLE ONE NUMBER)

   1 DEFINITELY NOT

   2 PROBABLY NOT

   3 PROBABLY YES

   4 DEFINITELY YES

3. Do you live in Northern Arizona?

   1 NO

   2 YES---->Skip to **Question 6**

4. Were you aware of the one-day <u>Glen Canyon</u> raft trip <u>before</u> you came to Northern Arizona? (CIRCLE ONE NUMBER)

   1 NO

   2 YES

5. Was the chance to go on this one-day raft trip through Glen Canyon an important reason to you in deciding to come to Northern Arizona? (CIRCLE ONE NUMBER)

   1 NOT AN IMPORTANT REASON

   2 A SOMEWHAT IMPORTANT REASON

   3 A VERY IMPORTANT REASON

   4 I WASN'T AWARE OF THE ONE-DAY RAFT TRIP WHEN I DECIDED

6. What was your main reason for taking the Glen Canyon raft trip? (CIRCLE ONLY ONE NUMBER)

   1 TO TAKE A TRIP THROUGH GLEN CANYON

   2 TO TAKE A TRIP ON THE COLORADO RIVER

   3 TO SEE SCENERY

   4 TO TAKE A RAFT TRIP

   5 TO RELAX AND ENJOY NATURE

   6 OTHER, please specify ______________________________

   ____

7. Including yourself, about how many people were there on this raft trip? (INCLUDE YOUR GUIDE OR TRIP LEADER AND PEOPLE ON OTHER RAFTS THAT WERE WITH YOUR RAFT.)

   _____PEOPLE

8. About how many people were on the same raft as you on your trip?

   _____PEOPLE

9. How many of your friends or family members accompanied you on this raft trip?

_____PEOPLE

10. On average, how crowded did you feel the river was when you were rafting on this trip? (Circle the number on the scale which best represents your feelings.)

1	2	3	4	5	6	7	8	9
Not at all Crowded		Slightly Crowded		Moderately Crowded			Extremely Crowded	

11. If you had a choice, what type of Glen Canyon raft trip would you prefer: (CIRCLE ONE NUMBER)

1 A TRIP STARTING WITH A **TOUR** OF GLEN CANYON DAM AND FLOATING DOWNSTREAM FROM THE BASE OF THE DAM TO LEE'S FERRY

2 A TRIP STARTING AT THE **BASE** OF GLEN CANYON DAM AND FLOATING DOWNSTREAM TO LEE'S FERRY (A TOUR OF THE DAM IS NOT INCLUDED)

3 A TRIP STARTING AT **LEE'S FERRY** AND MOTORING PART OF THE WAY TO THE DAM BEFORE FLOATING BACK DOWNSTREAM (PASSENGERS CANNOT VIEW THE DAM FROM THE RIVER)

12. Please estimate how much your raft trip cost (COSTS FOR YOU INDIVIDUALLY, NOT OTHERS FOR WHOM YOU MIGHT HAVE PAID). (Include only money spent on items specifically for this raft trip. If a certain item was not purchased for this trip, please put $0).

Payment to Rafting Company	$__________
Food and Beverages (not supplied by raft company)	$__________
Personal Gear (sunglasses, suntan lotion, film for camera, etc.)	$__________
Other, please specify ____________________	$__________
TOTAL AMOUNT TRIP COST [Please add all costs and fill in the total on this line.]	$__________

13. Would you still have gone on the Glen Canyon raft trip if your costs had been $______ **MORE** than the total you just calculated in Question 12? (CIRCLE ONE NUMBER)

1 YES, I WOULD PAY THAT AMOUNT TO TAKE THE TRIP

2 NO, I WOULD NOT PAY THAT AMOUNT TO TAKE THE TRIP

14. To help us better understand your responses to question 13, we would like to know the extent to which various factors affected your answers. Please tell us whether the following statements were true or not for you when answering question 13. (CIRCLE ONE RESPONSE FOR EACH STATEMENT)

	Definitely True	Probably True	Probably False	Definitely False
My main concern was that the Park Service might start charging a fee for Glen Canyon raft trips.	1	2	3	4
My main concern was that the rafting company might increase the price of Glen Canyon raft trips.	1	2	3	4
My response reflected my best guess as to whether I would really pay the specified amount for a Glen Canyon raft trip.	1	2	3	4
My response reflected the fact that I feel the Glen Canyon rafting experience should be maintained for all people to enjoy.	1	2	3	4
My response reflected the fact that I just don't know how much more I would really pay for a Glen Canyon raft trip.	1	2	3	4
My response reflected the fact that I just don't want to pay more for a Glen Canyon raft trip.	1	2	3	4

Other, please describe: ______________________________

____

In this last section we would like to ask you some questions about your background which will help us compare your answers to those of other people. We would stress that all of your answers are strictly confidential.

---

1. How old are you? _____ years old

2. Are you: 1 MALE

   2 FEMALE

3. How many years of school have you completed? (CIRCLE OR CHECK THE CORRECT RESPONSE)

   1 2 3 4 5 6 7 8 9 10 11 12

   ___ some college or technical school

   ___ B.A. or equivalent

   ___ M.A. or equivalent

   ___ Advanced degree (L.L.D., M.D., Ph.D., etc.)

4. Please circle the response that comes closest to your total family income before taxes. If you are a student and unmarried, please give your parents' income. (CIRCLE ONE NUMBER)

   1 Less than $10,000
   2 $10,000 to $14,999
   3 $15,000 to $19,999
   4 $20,000 to $24,999
   5 $25,000 to $29,999
   6 $30,000 to $34,999
   7 $35,000 to $39,999
   8 $40,000 to $44,999
   9 $45,000 to $49,999
   10 $50,000 to $59,999
   11 $60,000 to $69,999
   12 $70,000 to $79,999
   13 $80,000 to $89,999
   14 $90,000 to $99,999
   15 $100,000 or more

THANK YOU FOR YOUR HELP!

APPENDIX K

GLEN CANYON ANGLER CONTINGENT-VALUATION PRETEST SURVEY AND RESULTS

APPENDIX K

GLEN CANYON ANGLER CONTINGENT-VALUATION PRETEST SURVEY AND RESULTS

Introduction

In this appendix we present the results of the contingent-valuation pretest survey of Glen Canyon Anglers. The purpose of this survey was two-fold. First, the pretest allowed us to refine the contingent-valuation survey instrument, as was done for the administration of all attribute and contingent-valuation (CV) surveys in the study. The second objective, and the unique aspect of the angler CV pretest survey, is that it was used to identify which of three CV questioning formats, iterative-bidding, open ended or dichotomous-choice, would be best to employ in the final CV surveys of all three user groups (anglers, white-water boaters and day-use rafters).

In the remainder of this appendix, we will present the results of the angler CV pretest survey and discuss the relative strengths and weaknesses of each of the three techniques of asking the CV question that were employed. After presenting the procedures used for this survey, we will move to a discussion of the empirical results and will close with a conclusion regarding the selection of a single CV technique to be used in the remaining surveys.

Procedures

Sampling. The sampling frame for this pretest survey consisted of anglers who fished at Lee's Ferry on 75 selected days between April 29 and December 19, 1985. A sampling period of this length was chosen to minimize the potential for a seasonal bias in the types of anglers selected to participate in the study. The same procedures, as were used for the angler on-site attribute surveys, were used to contact anglers and to solicit their names and addresses for the CV mail survey.

Our field personnel estimated that 986 anglers were eligible for selection on the 75 specified sampling days, and they were able to contact 900 (91 percent). Some anglers were missed during busy times at the dock, while others had not returned by dark. For the 900 anglers contacted, 774 completed the on-site questionnaire (86 percent) and provided a usable name and address for the mail survey. The remaining 126 anglers either declined to complete the on-site questionnaire or listed insufficient or illegible address information. The sampling frame, then, contained 86 percent of the anglers contacted and 78 percent of the estimated total number of anglers.

Three hundred of the anglers who provided usable address information during the period April 29 through July 29, 1985 were selected to participate in the pretest survey.

Survey Design. Respondents were asked to answer a total of five contingent-valuation questions in the surveys. First, they were asked to evaluate their actual trip when they were contacted for their on-site preliminary interview. Three flow scenarios were then evaluated, 3,000, 10,000 and 40,000 cfs. Constant flows, and two environmental impact scenarios (doubling the chances of catching a trophy fish and halving the probability of catching no fish, getting "skunked").

To compare the three techniques of asking the CV question, respondents were randomly assigned to three groups and all individuals within a subgroup responded to the same CV technique. The comparison of techniques was based on six criteria of performance. The first we will refer to as the "performance relative to preferences" criterion. This requires a CV technique to rank alternatives in the same order as direct measures of preferences. As an example, if a substantial majority of anglers prefer a constant flow of 15,000 cfs to a fluctuating flow with an average of 5,000 cfs, then the 15,000 cfs constant flow should generate a higher CV value. Second, CV techniques must perform well relative to each other. If, for example, two techniques provided comparable results, but a third technique yields dramatically different results, then the third technique, all other factors equal, would be judged inferior. Third, a "good" response rate to a survey is a necessary, although by no means a sufficient, condition for a sample to adequately represent the population from which it is drawn. A CV technique which generates a low response rate relative to other techniques, either for the survey as a whole for the CV questions themselves (so-called item nonresponse), would be deemed inferior. The fourth criterion is particular to the current study. As explained above, respondents were asked to evaluate several different scenarios, as well as their actual trips. Thus, if a CV technique must be capable of being applied to individuals to evaluate several exercises within the same survey. The fifth criterion involves the degree of complexity of data analysis associated with a technique, and the complexity of explaining the technique, data analysis and results to decision makers. The more difficult the data analysis and/or the harder the results are to explain for a given technique, the lower this format of asking the CV question would be rated. Finally, the sixth criterion deals with the expense of applying a CV technique. The consideration here is that if two CV techniques produce comparable results, yet one technique is considerably cheaper to apply, the less expensive technique would be preferred.

CV Questioning Formats. Before proceeding it will be helpful to briefly explain each of the three CV question formats to be compared here. Such a discussion will facilitate the presentation of results in the remainder of this appendix and will help to identify the basic differences between each of the questioning formats.

Iterative-bidding is the oldest and most commonly used CV technique. The bidding process is conducted in the following manner. As is done in all contingent-valuation studies, the first step is to describe the item to be valued and a hypothetical market for trading the item to a respondent. A traditional bidding application begins when the interviewer suggests an initial (starting) bid to the respondent. If the respondent is willing to pay the initial bid, the interviewer revises the bid upward until a negative response is obtained. A negative response to the initial bid results in the interviewer revising the bid downward until an acceptable amount is found. The final bid is a measure of the respondents' surplus value for the item in question.

In a study that uses the dichotomous-choice technique, the nonmarket item to be valued and a hypothetical market for trading the item are described to the respondent, just as is done for iterative-bidding. Subsequently, a respondent is asked to state whether he or she is willing to accept or reject a single take-it-or-leave-it offer for the item being valued. Respondents are not asked to state a specific dollar value. Respondents' yes and no responses to the dollar offers, and the offers themselves, are used to derive estimates of value.

A technique that has been used in several contingent-valuation studies is an open-ended questioning format. Open-ended questions simply entail asking respondents what the maximum is that they would pay for an item being valued.

Survey Procedures. Individuals in the pretest were randomly assigned to receive a mail survey with <u>one</u> of the three types of CV questions. Each respondent was informed of the average flow and range of fluctuations on the day when the interview was completed. This information was designed to give respondents a point of reference in considering the flow scenarios. Two members of the dichotomous-choice group had to be deleted because their interview days fall into a gap in our data on flows. Advance letters to all members of the open-ended group and half of the members of the bidding game and dichotomous-choice groups were mailed on August 7, 1985. One week later, a questionnaire and cover letter were mailed, followed by a reminder/thank you postcard a few days after that. Two weeks after the first questionnaire mailing nonrespondents were mailed a second questionnaire. A third questionnaire and letter were sent by certified mail in mid-September to remaining nonrespondents.

Responses from the first group were used to initiate bidding for the iterative-bidding application and the offers for the second half of the dichotomous-choice group. Dichotomous-choice offers need to fully cover the range of relevant values. Questionnaires were mailed to these subsamples on August 27, followed by a reminder/thank you postcard. The second questionnaire went out on September 14 and the certified mailing on September 25. The response rates for the mail questionnaires as a percent of delivered questionnaires was 82 percent for the bidding game group, 77 percent for the dichotomous-choice group, and 86 percent for the open ended group, for an overall response rate of 81 percent.

Pretest Survey Results

The estimated surplus values are quite similar for each of the questioning formats (Table K-1). Pairwise statistical comparisons of the bidding-games and the open-ended estimates failed to show significant differences for the actual trip and for each of the scenarios. The dichotomous-choice values are derived from estimated logit models, so that direct comparisons of means across valuation techniques was not possible for these values. However, it is worthwhile noting that the dichotomous-choice values were well within the 95 percent confidence intervals for the respective iterative-bidding means and open-ended means. Thus, there seemed to be no statistical grounds for rejecting the null hypothesis that, for the actual trip and each of the scenarios, the three techniques yielded essentially the same values per trip except for sampling error.

Confidence in this conclusion is bolstered by observing that, with one minor exception, the three methods give the same rankings for the actual trip and scenarios: All rank the actual trip first, the trophy fish scenario second, the "reduce chances of getting skunked" scenario third, and so on. The exception involves whether the 3,000 cfs scenario is ranked just above or just below the 40,000 cfs scenario. Given the closeness in the values of these two scenarios (and the lack of a statistically significant difference in values), this discrepancy is not like attributable to sampling error rather than any real differences in values.

Table K-1. Results for Three CV Techniques Used in Pretest

	Iterative-Bidding		Open-Ended (Protest Zeroes Excluded)		Dichotomous-Choice	
	Value	Rank	Value	Rank	Value	Rank
Actual Trip (averaged 33,000 cfs)	$124	2	$121	2	$147	2
3,000 cfs Scenario	66	6	76	5	70	5
10,000 cfs Scenario	109	4	99	4	96	4
40,000 cfs Scenario	86	5	64	6	68	6
Double Chances of Trophy	146	1	128	1	163	1
Reduce Chances of Catching Nothing	106	3	106	3	100	3

To compare this ranking with preferences, three measures of preferences will be used. The first has to do with how each respondent compared the flow scenario with her or his actual trip. Results for all three subsamples combined are shown in Table K-2. This table is a little hard to follow at first, but provides some very relevant information. It says, for example, that 62 percent of the respondents considered 10,000 cfs superior to the flow during their actual trip. A total of 53 percent considered 3,000 cfs to be worse and 47 percent thought 40,000 cfs would be worse. The average daily flow actually experienced averaged 33,000 cfs, but varied between 19,000 cfs and 45,000 cfs.

Table K-2. Percent of Respondents Rating the Scenarios "Better Than," "Worse Than," and "About the Same As" Their Actual Trip

	3,000 cfs Scenario	10,000 cfs Scenario	40,000 cfs Scenario
Better	30%	62%	7%
Worse	53	9	47
About the Same	17	29	46

Table K-3 presents additional data on preferences. These data are from the on-site interviews in the Lee's Ferry Area so there had not been any opportunity yet for material in the scenarios or elsewhere in the mail survey to influence people's views. The interview form asked how the person would rate the water level that day. While 59 percent responded "about right," those who preferred a different flow indicated that the flow that day was "too high." Furthermore, this tendency was even more pronounced when respondents were divided into those who actually experienced less than 30,000 cfs and those that experienced more than 30,000 cfs. Here 24 percent of the lower flow group thought the water was too high while the comparable percentage for those experiencing higher flows was 54 percent.

Table K-3. Ratings of Water Level During Actual Trip (in percentages of respondents)

	Overall	Those Experiencing Less Than 30,000 cfs	Those Experiencing More Than 30,000 cfs
Too High	36%	24%	54%
About Right	59	69	45
Too Low	5	7	1

A third bit of evidence comes from questions posed as part of each scenario asking whether the respondent would take more or fewer trips under the scenarios than he or she had taken in an average year. People "vote with their feet," as the saying goes. As we have already seen in reviewing the history of the Glen Canyon fishery, angler participation rates can fluctuate widely with changes in fishing conditions. Thus, while the absolute magnitude of the numbers may not be terribly reliable, expressions of intention about number of trips do indicate preferences. Responses to the question about changes in participation are given in Table K-4. As might be expected the anglers in our survey were never unanimous about how their participation would change in response to the scenarios. For all scenarios, some said they would take fewer trips and some more trips. The total numbers of fewer trips taken by all embers of the sample are given in the first column of numbers. Others said they would take more trips and the total additional trips by all members of our sample combined are given in the second column of figures. The net changes in trips for the sample are given in the third column. Finally, the percentage changes are calculated in the last column based on the 544 trips respondents reported having taken to Lee's Ferry in the preceding 12 months.

Table K-4. Effects of Scenarios on Trips Taken In An Average Year

	Fewer Trips Taken by Sample	More Trips Taken by Sample	Net Change In Trips Taken
3,000 cfs	134 trips	69 trips	- 65 trips
10,000 cfs	17	169	+152
40,000 cfs	138	47	- 91
Double chances of trophy	21	336	+315
Reduce chances of no fish	66	115	+ 49

*Based on 544 trips reported actually taken in the last 12 months

Most impressive, although not surprising given the attribute survey results, is the huge increase in intended trips in response to a doubling of chances to catch a trophy fish. Also, there is a clear mandate in favor of 10,000 cfs and against 3,000 and 40,000 cfs. Reducing the chances of getting skunked does not result in a particularly strong positive reaction.

Though Glen Canyon anglers are by no means unanimous, these three tables combine to show a definite preferences for flows in the middle range between say, 10,000 and 20,000 cfs and a tendency to judge extremely low and high flows as inferior. These results are consistent with those from the attribute survey.

Returning now to the criterion of consistency between preferences and CV values, there are both favorable and unfavorable observations to be made. On the favorable side, all three CV techniques were consistent with our preference measures in ranking the three flow scenarios. That is, 10,000 cfs had larger values than either 3,000 cfs or 10,000 cfs. A few of the value differences across the flow scenarios were not statistically significant, but enough were significant and the level of consistency across CV techniques was so great that we are convinced of overall consistency between preferences and flow scenario values regardless of the CV technique used. Also favorable were the relatively large value for the trophy fish question. This result is consistent with the history of the fishery, the results of the attribute survey, and the results are presented in Table K-4.

On the other hand, the actual trip value is problematical. It turns out consistently higher than the value of the 10,000 cfs scenario and the scenario where the chances of getting skunked were cut in half. This is an anomaly since the average actual flow was 33,000 cfs and getting skunked is definitely a negative attribute. However, this appears to be a problem with all three techniques. One technique is not necessarily superior to another in this regard. One plausible explanation is that people tend to give higher values for actual experiences than for scenarios. Doubling the chances of catching a trophy fish is sufficiently attractive to overcome this tendency, but the relative attractiveness of 10,000 cfs is not large enough to do so. This same tendency will be somewhat visible in the white water boater results although statistical testing there will be difficult. Perhaps people tend to be more conservative across the board when expressing values for scenarios. The higher value for the actual trip relative to the getting skunked scenario would also be consistent with this explanation although here the differences are not strong enough to show up as statistically significant.

At any rate, our conclusion was that except for anomalies associated with the actual trip value, the CV techniques were all consistent with preferences and none was more so than the others.

Concerning internal consistency among the CV methods -- the second criterion -- the nearly equivalent rankings of the actual trip and the scenarios indicates that there too the three CV methods are performing similarly. An additional test is nevertheless of interest. Random variables may have similar means yet have very different distributions. Table K-5 shows statistics for testing hypotheses that the distribution of bids from the iterative-bidding and open-ended responses are the same as the distributions of values implied by the dichotomous-choice responses. It turns out that the bidding games and dichotomous-choice responses imply statistically indistinguishable distributions in all cases except the actual trip, while differences are significant for the actual trip and two scenarios in the case of the open-ended responses. Stated differently, people's behavior in answering iterative-bidding and dichotomous-choice questions appears to be quite consistent, except for the actual trip question, statistically significant differences in behavior turn up for the actual trip and two scenarios when dichotomous-choice and open-ended responses are compared. These results tend to support iterative-bidding and dichotomous-choice questions over open-ended questions.

Table K-5. Test Statistics from Test of Hypothesis That Distribution of Bids in Open-Ended or Iterative-Bidding Formats is Consistent with the Estimated Dichotomous-Choice Distributions

	Iterative-Bidding	Open Ended
Actual experience	.2314*	.2683*
Low water	.1193	.1201
Moderate Water	.1495	.2557*
High Water	.0935	.1539
Doubling Chances	.1179	.2461*
Reducing Chance of Getting Skunked	.0859	.1428

* Indicates a significant difference from the dichotomous-choice model

The third criterion is response rate. Here dichotomous-choice appears to have an advantage. Because the Glen Canyon fishery attracts anglers from a broad geographic area and because it appeared to be infeasible to conduct the full survey by personal interview at Lee's Ferry, the best practical alternative for conducting the bidding games was a combined mail survey and telephone interview. As noted previously, the combination of nonresponse to the mail survey and difficulty in re-contacting all mail survey respondents by telephone made for a relatively low response rate. Further efforts to contact people by phone might have improved the response rate somewhat, but we are not optimistic. One alternative would have been to eliminate the mail survey component altogether and do the entire survey by telephone. However, to do perhaps ten bidding games and gather the needed additional information would have made for a very long interview.

The problem with open-ended questions is the number of zero responses. When zeroes imply that no surplus is present they represent valid values, but zeroes can also imply an unwillingness to answer. Such protest responses are a form of item nonresponse. Little can be done about them other than excluding them entirely from the analysis. To be sure, some of the same people may simply answer "no" to dichotomous-choice questions regardless of the offer amounts. However, we suspect that this is much less prevalent than zero responses to open-ended questions. Open-ended questions ask people to state their maximum values, and this is likely to be much more difficult and seem much more unrealistic than simply responding "yes" or "no" to a specific amount.

The CV technique finally chosen for this study needed to be capable of application to the actual trip and several scenarios. We proposed that dichotomous-choice is the easiest of the three CV techniques for respondents to deal with and hence should be the most amenable to surveys where several CV exercises must be conducted. The pretest results did not produce any empirical evidence to support or refute this argument. Respondent fatigue did not appear to affect the results under any of the three CV techniques. Thus, our endorsement of dichotomous-choice techniques in this regard remains an intuitively appealing hypothesis for further research.

Regarding the ease with which results can be analyzed and explained to decision makers and the public, bidding games and open-ended questions have a definite edge. While we have developed computer programs to analyze dichotomous-choice data and estimate values easily, the problems with explaining and interpreting the results to noneconomists become readily apparent in Chapter 3.

On the expense side, the open-ended and dichotomous-choice techniques have the advantage. Bidding games, if applied in this study, would require telephone interviews. This would make bidding games substantially more expensive than the other two techniques.

Conclusion

In the end, the decision was to go with dichotomous-choice in the angler, white-water boater, and day-use rafter CV surveys. Dichotomous-choice had shown itself to work at least as well as other techniques in the research on validity of CV reported in Chapter 2, particularly in the valuation of Sandhill deer hunting permits. In the present study, it gave values that were roughly equivalent to the bidding-game and open-ended results that corresponded equally well to preference rankings. Furthermore, responses to bidding games and dichotomous-choice questions involving scenarios produced empirical value distributions that could not be distinguished from each other statistically. Prospects for a relatively high response rate seemed better with dichotomous-choice, and dichotomous-choice is cheaper.

APPENDIX L

TECHNICAL CONSIDERATIONS FOR DERIVING SURPLUS VALUES FROM RESPONSES TO DICHOTOMOUS-CHOICE VALUATION QUESTIONS

The surplus values presented in the body of this report were derived from the analyses of respondents' answers to the actual trip and the scenario contingent-valuation questions. The procedure used to ask these valuation questions is commonly referred to as the "dichotomous-choice" technique. The application of this technique involved asking respondents whether they would pay a specific amount (offer), above and beyond their actual trip expenses, to take their actual trip and a number of scenarios of plausible Grand Canyon white-water trips or Glen Canyon fishing trips. A separate valuation question was used for each of the trips. The offers for each of these valuation questions were randomly assigned to questionnaires based on the findings from the analyses of response to comparable questions in the CV pretest surveys.

Respondents' answers to the valuation questions were analyzed using logit models. A logit model is a special case of a general group of models, known as probabilistic models, that can be used to analyze qualitative response data. The qualitative responses here are respondents' "yes" and "no" answers to the valuation questions. The general form of a logit model can be specified as

$$Pr(YES) = [1 + \exp(f(x))]^{-1}$$

where Pr(YES) is the probability that a respondent will answer yes to a specific valuation question, exp indicates exponential notation (e), and f(x) is a function of variables, including the offer, which may influence respondents' answers to the valuation questions. A separate logit equation is estimated for each valuation question so the number and types of variables included in the f(x) term may vary with the situation being evaluated. For the current analyses the following functional form of the f(x) term was used:

$$f(x) = b_0 + \sum_{i=1}^{n} b_i x_i$$

where b_0 and the b_i are parameters to be estimated, the x_i are variables that are hypothesized to influence respondents' answers to a valuation question, and n is the number of variables included in a specific logit equation (see Hanneman, 1984, for a discussion of the choice of a functional specification of the f(x) term).

The logit equations were estimated using a maximum likelihood procedure and the estimated equations were used to calculate expected surplus values. That is,

$$Pr(NO) = 1 - Pr(YES)$$

since yes and no are the only possible answers to the valuation questions and the two answer categories are mutually exclusive events. Since Pr(NO) represents a cumulative distribution function (c.d.f.), the above equation can be rewritten as

$$Pr(NO) = F(X_1 | X_j,\ j=2,3,\ldots,n)$$

where F( ) is a c.d.f., X_1 is the offer variable from the valuation question and the X_j are fixed levels of the other variables in the logit equation. Thus, F( ) represents the probability that a typical respondent will answer no to a valuation question with a specific offer amount, given certain levels of the other variables (X_j's).

Surplus values that are conditioned on specified levels of the X_j variables are calculated from the estimated logit equations as:

$$E(X_1 | X_j, j=2,3,\ldots,n) = \int_0^\infty [1 - F(X_1 | X_j, j=2,3,\ldots,n)]dx_1$$

$$= \int_0^\infty \hat{Pr}(YES)dx_1$$

where E( ) denotes expected value and the right-hand side of the equation is the integral of the appropriate logit equation with the estimated parameters entered in the equation $[\hat{Pr}(YES)]$ and variables other than the offer are evaluated at the specified levels. Rather than solving this integral explicitly, numerical integration procedures were used to derive surplus values. This was done to simplify the analysis and to facilitate the derivation of surplus values using a computer. We did compare some of the surplus values calculated by numerical approximation with those from the exact solutions and found that the margin of error was less than 1 percent.

An unconditional surplus value is calculated as

$$E(X_1) = \sum_{j,k} [\int_0^\infty \hat{Pr}(YES)dx_1]g_j(x_{jk})$$

where this unconditional surplus value is simply the weighted average of all of the conditional surplus values calculated in the manner outlined above, g_j( ) are the observed probability distributions of the X_j variables, and X_{jk} is the kth value of jth variable. This calculation is based on the implicit assumption that all of the X_j variables have discrete probability distributions. For the current analyses this assumption will be true.

APPENDIX M

ANALYSES OF RESPONDENTS' ANSWERS TO THE WHITE-WATER BOATER CONTINGENT-VALUATION QUESTIONS

Actual Trip

The variables examined in the logit analysis of respondents' answers to the actual trip valuation question are outlined below. These variables are:

X_1 = OFFER =	the dollar amount from the actual trip valuation question;
X_2 = EXPENSE =	the amount a respondent spent to take their actual trip;
X_3 = MOTOR =	1 if a respondents' trip was in a motor raft and 0 if not;
X_4 = PADDLE =	1 if a respondents' trip was in a paddle raft and 0 if not;
X_5 = DORY =	1 if a respondents' trip was in a dory and 0 if not;
X_6 = KAYAK =	1 if a respondent used a kayak and 0 if not;
X_7 = DAYS =	the number of days spent on the river;
X_8 = CROWD =	an integer scale, ranging from 1 to 9, reflecting how crowded a respondent felt the river was with other boaters during his or her trip;
X_9 = WALK =	1 if a respondent had to walk around a rapid and 0 if not;
X_{10} = WATERLVL =	an integer scale, ranging from -1 to 1, reflecting a respondents' preference for an optimum flow level relative to what they actually experienced (-1 lower, 0=same, and 1=higher);

X_{11} = HIKING = 1 if a respondent felt that she or he had enough time for hiking and seeing attraction sites, and 0 if not;

X_{12} = SHARBEACH = 1 if a respondent ever had to share a beach for camping and 0 if not;

X_{13} = FEE = 1 if a respondent felt his or her answers to the valuation questions would affect the cost of Grand Canyon white water trips and 0 if not;

X_{14} = CONFIDENCE = 1 if a respondent was not confident in his or her answers to the valuation questions and 0 if not;

X_{15} = FEEOFFER = FEE multiplied by OFFER;

X_{16} = CONFIDENCEOFFER = CONFIDENCE multiplied by OFFER;

X_{17} = FLOW = average flow (in cfs) experienced by a respondent divided by 1,000; and

X_{18} = FLOWSQ = FLOW squared.

Four types of variables were included in the analysis. Variable X_1 is included because it is the dollar amount respondents were asked to consider in the actual trip valuation question. The offers ranged from $4 to $1729, with an average of $670. The assignment of specific dollar amounts to the surveys was random. The second group of variables, X_2 through X_{12}, are characteristics of respondents' actual trips, each of which may affect how a respondent answered the valuation question. The expense variable (X_2) can be thought of as representing the price of a Grand Canyon white water boating trip.

Contingent-valuation data sets are typically examined to identify responses to the valuation question that are deemed to be invalid. To address this issue we included variables X_{13} through X_{16}. The purpose of these variables was to determine whether respondents concerns about costs and confidence in their answers to the valuation questions would significantly affect surplus values. If the estimated parameters for either of these variables turns out to be significant, the variable(s) will be evaluated at a value of zero in the computation of surplus values. This will be done to control for these types of effects which should not enter into the computation of surplus values.

The average daily flow levels experienced were modeled as average flow and average flow squared to account for the fact that surplus values decline after some optimum flow level. We examined several different functional specifications of the flow variables and found that the specification using flow and flow squared fit the data best. We did not model fluctuating flow levels for the actual trip because only 12 percent of the respondents experienced a daily fluctuation in excess of 10,000 cfs, and the largest fluctuation experienced was 16,600 cfs.

We found that only a few of the variables outlined above had a statistically significant effect on respondents' answers to the actual trip valuation question. The variables with significant parameters for commercial passengers were: OFFER, EXPENSES, WATERLVL, FEE, FLOW, and FLOWSQ. For private boaters, the variables with significant parameters were: OFFER, EXPENSES, CROWD, SHARBEACH, FEE, FLOW, and FLOWSQ. Logit equations which only include these variables with significant parameters are presented in Table M-1. Statistical significance is denoted by an asterisk to the upper right of an estimated parameter. The constant term (b_0) is statistically different from zero for commercial passengers, but is not for private boaters. Variables with significant parameters are interpreted as having a significant effect on respondents answers to the valuation question and, consequently, will affect calculated surplus values. Variables which have insignificant parameters, on the other hand, do not have an effect. It is important, and interesting, to note that the type of boat a respondent used did <u>not</u> have a significant effect

Table M-1. Estimated Parameters for Respondents' Actual Trip Logit Equations

Variable	Parameter	Equation	
		Commercial Passengers	Private Boaters
----------	b_0	3.4505*[a] (1.6913)[b]	0.4188 (2.2630)
OFFER	b_1	0.0037* (0.0005)	0.0052* (0.0013)
EXPENSES	b_2	-0.0011* (0.0003)	-0.0009* (0.0005)
CROWD	b_8	-------	0.5633* (0.1619)
WATERLVL	b_{10}	0.6691* (0.3134)	-------
SHARBEACH	b_{12}	-------	0.9737* (0.5030)
FEE	b_{13}	1.3898* (0.2909)	2.1228* (0.5300)
FLOW	b_{17}	-0.3115* (0.1117)	-0.4118* (0.1631)
FLOWSQ	b_{18}	0.0047* (0.0018)	0.0070* (0.0030)
-------		320.95[c]	112.88
--------	N	303	150

a/ An asterisk denotes significance of the parameter at the 0.10 level.

b/ Numbers in parentheses are asymptotic standard errors.

c/ The Chi-square statistics are used to test the null hypothesis that all of the estimated parameters in an equation are zero simultaneously. The degrees of freedom are computed by subtracting one from the number of parameters estimated. The null hypothesis is rejected if the reported Chi-square statistic exceeds the table value for the appropriate degrees of freedom.

on estimated surplus values. The estimated logit questions were used to compute the actual trip surplus values for constant flow levels plotted in Figure 5-1 of the text.

The omission of insignificant variables did not appear to have affected the magnitude of the estimated parameters for the included variables. The logic for estimating a logit equation that only includes variables with significant parameters is as follows. For survey data, each variable may have some missing observations associated with it since some respondents do not answer all of the questions in a survey. As a result, these missing responses censor the number of observations that can be used for estimation purposes. To make the best use of our data for estimating the actual trip logit equation and the calculation of an actual trip surplus value, we created a data set for estimation purposes which only included the variables with statistically significant parameters and consequently were determined to have a significant effect on respondents' answers to the actual trip valuation question. Thus, there would be fewer observations censored by missing data and we could use more respondents' answers to the actual trip valuation question.

Most of the parameters in the estimated equation have the expected signs. It is important to note that due to the specific functional form of a logit equation, the signs on the parameters are reversed from what intuition might lead one to expect, based on a linear regression model. That is, one would expect the probability of a yes response to the valuation question to decline as the magnitude of the offer increases. For this result to occur in a logit equation, the parameter on the OFFER variable must have a positive sign.

An unexpected finding was that respondents' surplus values increased with the amount they spent to take their actual trip. This result contradicts what economic theory would tell us the sign on this variable should be. That is, the more an individual pays for their trip the lower should be their surplus values, all other factors equal. However, this is not the case here.

We also found that surplus values were significantly lower for respondents who felt their answers to the valuation questions would affect the cost of boating in the Grand Canyon. To control for this undesirable effect, the FEE variable was evaluated at zero for the computation of surplus values.

Finally, the optimum flow levels for both groups of respondents are computed by substituting the estimated logit parameter into the f(x) term from the logit equation and by taking the first derivative of [f(x)] with respect to the FLOW variable. This derivative when evaluated at zero can be used to solve for the optimum flow levels. The resulting flow is an optimum only if the second derivative of f(x) with respect to flow is negative.

Scenarios

A separate logit equation was estimated for each of the seven scenarios, and each of the equations included the same set of variables. The variables included in the logit equations for the scenarios are:

X_1 = OFFER;
X_2 = EXPENSE;
X_3 = FEE;
X_4 = CONFIDENCE;
X_5 = FEEOFFER; and
X_6 = CONFIDENCEOFFER.

All of these variables were defined for the actual trip logit equation so we will not repeat those definitions here. It is important to note, however, that the distribution of OFFERS varied across contingent-valuation questions for each of the scenarios.

The estimated logit equations for each of the scenarios are presented in Table M-2 for commercial passengers and those for private boaters are presented in Table M-3. These equations were used to calculate the scenario surplus values reported in the text.

The reported equations do not include the FEE, FEEOFFER, CONFIDENCE, and CONFIDENCEOFFER variables as the analysis revealed that the parameters on these variables were not generally significant. So, we used the subset of variables with significant parameters for the estimated equations reported here. This is the same procedure we used for the analysis of the actual trip valuation data to make use of a larger number of respondents' answers to the valuation question.

The parameters for the OFFER variable in Tables M-2 and M-3 are significant in all of the equations, and the parameters on the EXPENSE variable are significant in nine of the fourteen equations. The parameter for the expense variable has the wrong sign in 13 of the 14 equations, a result we also observed in the estimates for the actual trip logit equations. For the equation where the parameter for the expense variable does have the correct sign, the parameter is insignificant.

Table M-2. Estimated Logit Parameters for Scenario Equations -- Commercial Passengers

Variable	Parameter	5,000 cfs Constant Flow	5,000 cfs W/Fluc	13,000 cfs Constant Flow	22,000 cfs Constant Flow	22,000 cfs W/Fluc	40,000 cfs Constant Flow	Beaches Reduced
-------	b_0	1.5982*[a] (0.5279)[b]	0.6880 (0.4499)	-0.5772 (0.4320)	-0.4373 (0.4637)	-0.7511* (0.4301)	-0.4896 (0.4333)	0.0659 (0.4094)
OFFER	b_1	0.0024* (0.0006)	0.0036* (0.0006)	0.0043* (0.0006)	0.0039* (0.0005)	0.0041* (0.0005)	0.0031* (0.0004)	0.0024* (0.0005)
EXPENSE	b_2	-0.0007* (0.0003)	-0.0007* (0.0003)	-0.0010* (0.0003)	-0.0013* (0.0003)	-0.0007* (0.0003)	-0.0004 (0.0003)	-0.0004* (0.0002)
-------		257.15[c]	295.20	348.59	354.95	323.58	341.40	405.33
-------	N	325[d]	323	321	322	326	326	324

a/ An asterisk denotes significance of the parameter at the 0.10 level.

b/ Numbers in parentheses are asymptotic standard errors.

c/ The Chi-square statistics are used to test the null hypothesis that all of the estimated parameters in an equation are zero simultaneously. The degrees of freedom are computed by subtracting one from the number of parameters estimated. The null hypothesis is rejected if the reported Chi-square statistic exceeds the table value for the appropriate degrees of freedom.

d/ The sample sizes vary across logit equations because some of the respondents did not answer all of the valuation questions in the survey.

Table M-3. Estimated Logit Parameters for Scenario Equations -- Private Boaters

Variable	Parameter	5,000 cfs Constant Flow	5,000 cfs W/Fluc	13,000 cfs Constant Flow	22,000 cfs Constant Flow	22,000 cfs W/Fluc	40,000 cfs Constant Flow	Beaches Reduced
-------	b_0	-0.3302 (0.3972)[a]	-0.2868 (0.3996)	-1.7769* (0.4553)	-1.8916* (0.5176)	-1.4730* (0.5483)	-1.7424* (0.4585)	-1.9645* (0.4693)
OFFER	b_1	0.0054*[b] (0.0011)	0.0050* (0.0010)	0.0049* (0.0008)	0.0044* (0.0008)	0.0055* (0.0009)	0.0047* (0.0008)	0.0055* (0.0010)
EXPENSE	b_2	-0.0011* (0.0004)	-0.0010* (0.0005)	-0.0011* (0.0005)	-0.0006 (0.0004)	-0.0010 (0.0007)	-0.0003 (0.0004)	0.0001 (0.0004)
-------		134.16[c]	154.17	158.90	171.83	150.33	147.04	175.88
-------	N	166[d]	164	165	166	164	165	166

a/ Numbers in parentheses are asymptotic standard errors.

b/ An asterisk denotes significance of the parameter at the 0.10 level.

c/ The Chi-square statistics are used to test the null hypothesis that all of the estimated parameters in an equation are zero simultaneously. The degrees of freedom are computed by subtracting one from the number of parameters estimated. The null hypothesis is rejected if the reported Chi-square statistic exceeds the table value for the appropriate degrees of freedom.

d/ The sample sizes vary across logit equations because some of the respondents did not answer all of the valuation questions in the survey.

Evaluation of the Effect of Scenario Sequence on Surplus Values

Since we asked a total of eight valuation questions in the survey, we were concerned that the placement of any specific scenario in the sequence of white water boating experiences to be evaluated might have affected respondents' answers to that valuation question. For example, if the 5,000 cfs constant flow scenario was the first white water boating experience evaluated and there was a sequence effect, we might expect respondents to give different answers to the associated valuation questions than they would if this were the last experience evaluated. However, if there is not an ordering effect, respondents' answers should be the same regardless of the placement of any specific scenario within the sequence of scenarios to be evaluated.

To examine the potential for this type of problem we randomly assigned respondents to two groups and reversed the order in which these two groups evaluated the scenarios. Individuals in both groups were asked an actual trip valuation question first. The sequence in which the scenarios were presented varied between the two groups. The exact order in which the scenarios were presented is shown in Table M-4. Note that a constant flow scenario always preceded the corresponding fluctuating flow scenario regardless of the overall sequence of the scenarios.

Table M-4. Sequence in Which Scenarios were Evaluated

Ascending Order	Descending Order
Actual Trip	Actual Trip
5,000 cfs Constant Flow	Beaches Reduced
5,000 cfs With Fluctuations	40,000 cfs Constant Flow
13,000 cfs Constant Flow	22,000 cfs Constant Flow
22,000 cfs Constant Flow	22,000 cfs With Fluctuations
22,000 cfs With Fluctuations	13,000 cfs Constant Flow
40,000 cfs Constant Flow	5,000 cfs Constant Flow
Beaches Reduced	5,000 cfs With Fluctuations

To address the issue of whether the sequence of scenarios affected the surplus values we estimated separate logit equations for each of these groups for each of the scenarios and statistically tested for differences between the estimated logit coefficients for the Acending Order group and the comparable estimates from the Descending Order group. The Chi-square statistics for all pairwise comparisons are reported in Table M-5. A statistically significant difference was identified for two of the comparisons for commercial passenger and three of the private boater scenario comparisons, i.e., the Chi-square statistics exceed 5.99 implying a significant difference at the 0.05 level. However, there does not appear to be a pattern to the occurrence of these significant differences and we would conclude that the sequence in which respondents evaluated the scenarios did not affect the calculated surplus values.

Table M-5. Comparison of Logit Estimates for Ascending Order and Descending Order Groups

Scenario	Chi-square Statistics	
	Commercial Passengers	Private Boaters
5,000 cfs Constant Flow	4.19[a]	6.16*
5,000 cfs With Fluctuations	0.46	5.41
13,000 cfs Constant Flow	5.39	11.14*
22,000 cfs Constant Flow	8.56*[b]	8.80*
22,000 cfs With Fluctuations	5.91	4.39
40,000 cfs Constant Flow	12.61*	2.61
Beaches Reduced	0.37	4.29

a/ The degrees of freedom corresponding to all of the Chi-square statistics are 2.

b/ An asterisk denotes a significant difference at the 0.05 level.

APPENDIX N

ANALYSES OF RESPONDENTS' ANSWERS TO THE ANGLER CONTINGENT-VALUATION QUESTIONS

Actual Trip

The variables examined in the logit analysis of respondents' answers to the actual trip valuation question are outlined below. These variables are:

X_1 = OFFER =	the dollar amount from the actual trip valuation question;
X_2 = EXPENSE =	the amount a respondent spent to take his or her actual fishing trip;
X_3 = GUIDE =	1 if a respondent hired a guide to take them fishing and 0 if not;
X_4 = SEASON =	1 if a respondents' trip occurred during the winter season (January 1 through April 15 and October 1 through December 31) and 0 if not;
X_5 = DAYS =	the number of days fished during trip;
X_6 = BOAT =	1 if a respondent fished from a boat and 0 if not;
X_7 = FISH =	the number of fish a respondent caught;
X_8 = SIZE =	1 if a respondent caught a fish larger than 3.0 pounds and 0 if not;
X_9 = COMMITMENT =	an integer scale, ranging from 1 to 4, reflecting respondents' commitment to fishing in Glen Canyon, with an increase in the integer reflecting an increase in commitment;
X_{10} = FEE =	1 if a respondent felt his or her answers to the valuation questions would affect the cost of fishing in Glen Canyon and 0 if not;

X_{11} = CONFIDENCE = 1 for respondents who indicated that they were not confident in their answers to the valuation questions and 0 if not;

X_{12} = FEEOFFER = FEE multiplied by OFFER; and

X_{13} = CONFIDENCEOFFER = CONFIDENCE multiplied by OFFER.

Five types of variables were included in the analysis. Variable X_1 is included because it is the dollar amount respondents were asked to consider in the actual trip valuation question. The offers ranged from $1 to $459, with an average of $156. The assignment of specific dollar amounts to the surveys was random. The second group of variables, X_2 through X_8, are characteristics of respondents' actual trips, each of which may affect how a respondent answered the valuation question. The expense variable can be thought of as representing the price of a fishing trip. Variable X_9 relates to respondents' subjective feelings about Glen Canyon angling.

Contingent-valuation data sets are typically examined to identify responses to the valuation question that are deemed to be invalid. To address this issue we included variables X_{10} thru X_{13} in the equation. The purpose of these variables was to determine whether a concern about costs would result in significantly lower surplus values or if respondents were not confident of their answers to the valuation questions. If the estimated parameters for either of these variables turns out to be significant, the variable(s) will be evaluated at a value of zero in the computation of surplus values. This will be done to control for these types of effects which should not enter into the computation of surplus values.

The average daily flow levels experienced, and also the amount of fluctuations in daily flow levels experienced, may also affect respondents' answers to the actual trip valuation question. We examined several different functional specifications of flow variables, such as average flow and average flow squared and splits of the data set between constant flow and fluctuating flow levels to determine whether the flow levels and fluctuations experienced had a statistically significant effect on actual trip surplus values.

We found that only a few of the variables outlined above had a statistically significant effect on respondents' answers to the actual trip valuation question. The variables with significant parameters were: OFFER, EXPENSES, and FEE. A logit equation which only includes these variables with significant parameters is presented in the first column of Table N-1. Statistical significance is denoted by an asterisk to the upper right of an estimated parameter. The constant term (b_0) is also statistically different from zero. Variables with significant parameters are interpreted as having a significant effect on respondents' answers to the valuation question and, consequently, will affect calculated surplus values. Variables which had insignificant parameters, on the other hand, do not have an effect. The omission of insignificant variables did not appear to have affected the magnitude of the estimated parameters for the included variables.

The logic for estimating a logit equation that only includes variables with significant parameters is as follows. For survey data, each variable may have some missing observations associated with it since some respondents do not answer all of the questions in a survey. As a result, these missing responses censor the number of observations that can be used for estimation purposes. To make the best use of our data for estimating the actual trip logit equation and the calculation of an actual trip surplus value, we created a data set for estimation purposes which only included the variables with statistically significant parameters and consequently were determined to have a significant effect on respondents' answers to the actual trip valuation question. Thus, there would be fewer

Table N-1. Estimated Parameters for Respondents' Actual Trip Logit Equations

Variable	Parameter	Equation		
		All Flows	Constant Flow	Fluctuating Flow
----------	b_0	-1.1297*[a] (0.4059)[b]	-1.8406* (0.6330)	-0.3416 (0.5939)
OFFER	b_1	0.0178* (0.0027)	0.0237* (0.0047)	0.0130* (0.0036)
EXPENSES	b_2	-0.0052 (0.0012)	-0.0036* (0.0018)	-0.0074* (0.0021)
FEE	b_{10}	0.6675* (0.3932)	0.3080 (0.5764)	1.1921* (0.6097)
-------		202.49[c]	89.27	104.69
-------	N	230	114	116

a/ An asterisk denotes significance of the parameter at the 0.10 level.

b/ Numbers in parentheses are asymptotic standard errors.

c/ The Chi-square statistics are used to test the null hypothesis that all of the estimated parameters in an equation are zero simultaneously. The degrees of freedom are computed by subtracting one from the number of parameters estimated. The null hypothesis is rejected if the reported Chi-square statistic exceeds the table value for the appropriate degrees of freedom.

observations censored by missing data and we could use more respondents' answers to the actual trip valuation question.

It is important to note that due to the specific functional form of a logit equation, the signs on the parameters are reversed from what intuition might lead one to expect, based on a linear regression model. That is, one would expect the probability of a yes response to the valuation question to decline as the magnitude of the offer increases. For this result to occur in a logit equation, the parameter on the OFFER variable must have a positive sign.

An unexpected finding was that respondents' surplus values increased with the amount they spent to take their actual Glen Canyon fishing trip. This result contradicts what economic theory would tell us the sign on this variable should be. That is, the more an individual pays for their trip the lower should be their surplus values, all other factors equal. However, this is not the case here.

We also found that surplus values were significantly lower for respondents who felt their answers to the valuation questions would affect the cost of fishing in Glen Canyon. To control for this undesirable effect, the FEE variable was evaluated at zero for the computation of surplus values.

Finally, we found that none of the estimated parameters for the flow variables, for any of the functional specifications examined for these variables, were statistically different from zero. That is, we were not able to make a direct link between the actual trip surplus value and the flow levels experienced by respondents within the estimated logit equation. We believe that this result is due to the limited variation in flow levels experienced by anglers for their actual trip. About one half of the respondents experienced a constant flow for their trip, while the other half experienced fluctuating flows. Of those who experienced a constant flow level, none experienced an average flow below 10,000 cfs, the optimum flow level derived from the analysis of scenarios, and 75 percent experienced an average daily flow between 20,000 and 30,000 cfs. In contrast, only two of the respondents who experienced a fluctuating flow level were on the river when the average flow exceeded 20,000 cfs. In fact, 75 percent of these respondents experienced an average daily flow between 5,000 and 15,000 cfs, and about 50 percent experienced an average daily flow between 8,000 and 12,000 cfs. Another complicating factor is that 11 percent of the respondents hired a guide to take them fishing and, as a result, they did not have to worry about maneuvering a boat on the river. One could also argue that a guide might know how to catch fish regardless of the flow level so a client would be likely to feel the experience was acceptable regardless of the flow regime during the time they were on the river. We believe that these examples highlight the types of perturbations in the data that complicated the derivation of a relationship between average flow levels and actual trip surplus values.

Even though we were not able to identify a significant relationship between flow variables and respondents' answers to the actual trip valuation question, we were able to split respondents into two groups according to whether they had experienced a constant or fluctuating flow for their actual trip. This split was made in the following manner. Respondents who experienced daily fluctuations in flows of less than 10,000 cfs were put in the constant flow group, while all other respondents were classified as having taken a trip under conditions of fluctuating flows. We estimated a separate logit equation for each of these two groupings of respondents. The estimated equations are reported in the second and third columns of Table N-1 and each equation includes the same set of explanatory variables as were reported in column one. We tested the two equations to see if they were statistically different and were able to conclude that there was a significant difference at the 0.01 level.[1/] Since there is a statistical difference according to whether respondents experienced a constant or fluctuating flow level for their actual trip, the logit equations in columns two and three of Table N-1 were used to compute the actual trip surplus values reported in the text.

Scenarios

A separate logit equation was estimated for each of the nine scenarios, and each of the equations included the same set of variables. The variables included in the logit equations for the scenarios are:

X_1 = OFFER;
X_2 = EXPENSE;
X_3 = FEE;
X_4 = COMMITMENT;
X_5 = FEEOFFER;
X_6 = COMMITMENTOFFER.

All of these variables were defined for the actual trip logit equation so we will not repeat those definitions here. It is important to note, however, that the distribution of OFFERS varied across contingent-valuation questions for each of the scenarios.

1/ The Chi-square statistic for this test is 8.53 with three degrees of freedom, indicating that the null hypothesis of no difference can be rejected at the 0.10 level.

The estimated logit equations for each of the scenarios are presented in Table N-2 under the respective scenario headings. As reported in the text, we did not find a statistically significant difference in respondents' answers to valuation questions for the 3,000 cfs constant flow and the 3,000 cfs fluctuating flow scenarios. Thus, we only report a logit equation for which respondents answers to these two scenarios were combined for estimation purposes. The equations reported in Table N-2 were used to calculate the constant flow surplus values reported in the text.

The reported equations do not include the FEE, FEEOFFER, CONFIDENCE, and CONFIDENCEOFFER variables as the analysis revealed that the parameters on these variables were not generally significant. So, we used the subset of variables with significant parameters for the estimated equations reported here. This is the same procedure we used for the analysis of the actual trip valuation data to make use of a larger number of respondents' answers to the valuation question.

The parameters for the OFFER variable in Table N-2 are significant in all of the equations, and the parameter on the EXPENSE variable is significant in six of the nine equations. The parameter for the EXPENSE variable has the wrong sign in seven of the eight equations, a result we also observed in the estimates for the actual trip logit equations. For the equation where the parameter for the EXPENSE variable does have the correct sign, the parameter is insignificant.

Table N-2. **Estimated Logit Parameters for Scenario Equations**

Variable	Parameter	3,000 cfs Constant or W/Fluc	10,000 cfs Constant Flow	10,000 cfs W/Fluc	25,000 cfs Constant Flow	25,000 cfs W/Fluc	40,000 cfs Constant Flow	Bigger Fish	Skunked
-------	b_0	-0.7759*[a] (0.2348)[b]	-0.6594* (0.3358)	0.1750 (0.3414)	-0.8841* (0.3247)	-0.0887 (0.3166)	0.6514* (0.3197)	-1.1694* (0.3591)	-0.0248 (0.3067)
OFFER	b_1	0.0163* (0.0022)	0.0127* (0.0025)	0.0115* (0.0027)	0.0167* (0.0027)	0.0139* (0.0028)	0.0091* (0.0027)	0.0125* (0.0021)	0.0142* (0.0029)
EXPENSE	b_2	0.0003 (0.0007)	-0.0047* (0.0012)	-0.0046* (0.0011)	-0.0029* (0.0010)	-0.0025* (0.0010)	-0.0012 (0.0011)	-0.0024* (0.0011)	-0.0025* (0.0011)
-------		471.61[c]	256.91	235.72	243.12	230.38	204.20	235.74	222.91
-------	N	446[d]	225	221	226	223	225	220	223

a/ An asterisk denotes significance of the parameter at the 0.10 level.

b/ Numbers in parentheses are asymptotic standard errors.

c/ The Chi-square statistics are used to test the null hypothesis that all of the estimated parameters in an equation are zero simultaneously. The degrees of freedom are computed by subtracting one from the number of parameters estimated. The null hypothesis is rejected if the reported Chi-square statistic exceeds the table value for the appropriate degrees of freedom.

d/ The sample sizes vary across logit equations because some of the respondents did not answer all of the valuation questions in the survey.

Evaluation of the Effect of Scenario Sequence on Surplus Values

Since we asked a total of ten valuation questions in the Glen Canyon Anglers' Survey, we were concerned that the placement of any specific scenario in the sequence of angling experiences to be evaluated might have affected respondents' answers to that valuation question. For example, if the 3,000 cfs constant flow scenario was the first angling experience evaluated and there was a sequence effect, we might expect respondents to give different answers to the associated valuation questions than they would if this angling experience were evaluated last. However, if there is not an ordering effect, respondents' answers should be the same regardless of the placement of any specific scenario within the sequence of scenarios to be evaluated.

To examine the potential for this type of problem we randomly assigned respondents to two groups and reversed the order in which these two groups evaluated the scenarios. Individuals in both groups were asked an actual trip valuation question first. The sequence in which the scenarios were presented varied between the two groups.

The exact order in which the scenarios were presented is shown in Table N-3. Note that a constant flow scenario always preceded the corresponding fluctuating flow scenario regardless of the overall sequence of the scenarios.

Table N-3. Sequence in Which Scenarios were Evaluated

Ascending Order	Descending Order
Actual Trip	Actual Trip
3,000 cfs Constant Flow	Getting Skunked
3,000 cfs With Fluctuations	Bigger Fish
10,000 cfs Constant Flow	40,000 cfs Constant Flow
10,000 cfs With Fluctuations	25,000 cfs Constant Flow
25,000 cfs Constant Flow	25,000 cfs With Fluctuations
25,000 cfs With Fluctuations	10,000 cfs Constant Flow
40,000 cfs Constant Flow	10,000 cfs With Fluctuations
Bigger Fish	3,000 cfs Constant Flow
Getting Skunked	3,000 cfs With Fluctuations

To address the issue of whether the scenario sequence affected surplus values we estimated separate logit equations for each of these groups for each of the scenarios and statistically tested for differences between the estimated logit coefficients for the Normal Order group and the comparable estimates from the Reversed Order group. The Chi-square statistics for all pairwise comparisons are reported in Table N-4. A statistically significant difference was identified for only one of the scenario comparisons. All of these statistics, except for the Getting Skunked scenarios, are less than 5.99, indicating that a significant difference does not exist between the estimated equations for these pairwise comparisons at the 0.05 level. Thus, we would conclude that the sequence in which respondents evaluated the scenarios did not affect the calculated surplus values.

Table N-4. Comparison of Logit Estimates for Ascending Order and Descending Order Groups

Scenario	Chi-square Statistics
3,000 cfs Constant Flow	2.18[a]
3,000 cfs With Fluctuations	5.50
10,000 cfs Constant Flow	1.76
10,000 cfs With Fluctuations	0.45
25,000 cfs Constant Flow	5.85
25,000 cfs With Fluctuations	5.27
40,000 cfs Constant Flow	5.19
Bigger Fish	2.61
Getting Skunked	9.26*[b]

a/ The degrees of freedom corresponding to all of the Chi-square statistics are 2.

b/ An asterick denotes a significant difference at the 0.05 level.

APPENDIX O

ANALYSES OF RESPONDENTS' ANSWERS TO THE GLEN CANYON DAY-USE RAFTER CONTINGENT-VALUATION QUESTION

Actual Trip

The variables examined in the logit analysis of respondents' answers to the actual trip valuation question are outlined below. These variables are:

X_1 = OFFER =	the dollar amount from the actual trip valuation question;
X_2 = EXPENSE =	the amount a respondent spent to take their actual trip;
X_3 = CROWD =	an integer scale, ranging from 1 to 9, reflecting how crowded a respondent felt the river was with other boaters during his or her trip;
X_4 = FEE =	1 if a respondent felt his or her answers to the valuation questions would affect the cost of Grand Canyon white water trips and 0 if not;
X_5 = CONFIDENCE =	1 if a respondent was not confident in his or her answers to the valuation questions and 0 if not;
X_6 = FEEOFFER =	FEE multiplied by OFFER;
X_7 = CONFIDENCEOFFER =	CONFIDENCE multiplied by OFFER;
X_8 = FLOW =	average flow (in cfs) experienced by a respondent divided by 1,000; and
X_9 = FLOWSQ =	FLOW squared.

All of the variables listed above were previously defined in Appendices L and M so we will not repeat these definitions here.

As was done in the estimation of the logit equations for white-water boaters and anglers, we only report an equation which includes variables with significant parameters. This was done to make the best use of our data because some respondents did not answer certain questions in the survey that were used to compute the various variables in the equation and, in turn, these nonrespondents censored the sample size used to estimate the first equation. Thus, by removing variables with insignificant parameters we increased our sample size for estimation purposes from 173 to 182. In turn, we were able to make use of more respondents answers to the valuation question. It is also important to note that the removal of the variables with insignificant parameters from the equation does not appear to have affected the magnitude of the estimates of b_1 or b_4.

The estimated parameters are presented in Table 0-1. Only the estimated parameter for the OFFER and FEE variables were significantly different from zero at the 0.10 level and have the appropriate signs.[1/] An insignificant parameter indicates that the corresponding variable did not have a statistically significant effect on respondents' answers to the valuation question. This equation was used to calculate the surplus value reported in the text.

1/ Because of the functional form of a logit equation, the signs on the parameters are the opposite of what one would expect from a regular linear regression model. Thus, as the magnitude of the OFFER increases, the probability of a yes response to the valuation question will decrease even though the sign of the parameter for this variable (b_1) is positive.

Table 0-1. Estimated Parameters For Respondents' Actual Trip Logit Equation

Variable	Parameter	Equation 2
-------	b_0	-1.7540*[a] (0.5333)
OFFER	b_1	0.0737*[b] (0.0184)
FEE	b_4	0.6430* (0.3274)
-------		218.68[c]
-------	N	182

a/ An asterisk denotes significance at the 0.10 level.

b/ Numbers in parentheses are asymptotic standard errors for the respective estimated parameters

c/ The Chi-square statistics are used to test whether all of the estimated parameters for a single equation are simultaneously statistically different from zero. Both of the Chi-square statistics reported here reveal that we can reject the hypothesis that all of the estimated parameters in each of the respective equations are simultaneously equal to zero.

0.4

LITERATURE CITED

Hanneman, Michael W. 1984. Welfare Evaluations in Contingent Valuation Experiments With Discrete Responses. American Journal of Agricultural Economics. 66: 332-341.