Chapter 9

Recreation Use Values and Nonuse Values of Glen and Grand Canyons

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Introduction

Grand Canyon and Glen Canyon are unique natural environments valued worldwide, providing world-class recreational activities and habitat for wildlife and endangered fish. This chapter discusses the various economic values of the Grand Canyon and Glen Canyon ecosystems, how these values are measured, and what we know about them. The economic value of the services provided by these ecosystems is also discussed. Other chapters in this report address related topics, including the potential effects of Grand Canyon campsite availability on recreation (chapter 12) and the hydropower values of Glen Canyon Dam (chapter 10).

This chapter focuses on how recreation use and economic values are influenced by alternative river flow regimes and Glen Canyon Dam operations. Recreation is of interest within the Glen Canyon Dam Adaptive Management Program for several reasons. First, the Grand Canyon Protection Act (GCPA) of 1992 expressly mentioned recreation as one of the three elements to be monitored. Specifically, the act stated that "long-term monitoring . . . shall include any necessary research and studies to determine the effect of the Secretary's actions . . . on the natural, recreational and cultural resources of Grand Canyon National Park and Glen Canyon National Recreation Area" (GCPA, sec. 1805(b)). Second, because Glen Canyon is a national recreation area and recreation is one of the dual mandates of national parks (Loomis, 2002), the effects of alternative dam operations on recreation should be expected to receive significant attention. Third, recreation use and value are of interest in an integrated scientific research effort because of potentially important linkages between various ecosystem components. For example, it becomes important to understand how changes in river flows influence trout size and abundance and how changes in fish population in turn influence recreation use and value.

As noted previously by the National Research Council (1999, p. 13), however, there has not been regular, systematic, or comprehensive monitoring of the effects of alternative flow regimes and other operational changes on recreation use and public values. Therefore, this chapter draws from research conducted over the last two decades to summarize the available information on recreation use, benefits, and public values of Grand and Glen Canyons. This partial information is the best available at the present time to inform adaptive management

(see Overview, this report) of Grand and Glen Canyons about the consequences of operational changes on recreation use and public values.

Background

Types of Economic Values Provided by Glen and Grand Canyons

Economic values can be divided into three main categories: (1) visitor use values such as recreation, (2) local economic effects associated with visitor spending that supports commercial outfitters, hotels, restaurants, and towns such as Page, Arizona, and (3) public nonuse values.

Use Values to Visitors

Most people are familiar with the local economic effects of visitor spending and the positive economic impacts of recreation and tourism in the form of jobs and local income. In addition, the visitors themselves also receive economic benefits from the actual recreation experience in the form of what is termed "consumer surplus." This consumer surplus represents the monetary measure of the increase in economic well being that a visitor receives, and would be willing to pay, over and above the existing cost of the recreational trip. Consumer surplus, or net willingness to pay, is the federally recommended measure of benefits for use by agencies such as the Bureau of Reclamation when conducting benefit-cost analyses (U.S. Water Resources Council, 1983).

As an example of consumer surplus, consider the case of private whitewater boating on the Colorado River through Grand Canyon. A private boater experiencing a long awaited and possibly once-in-a-lifetime trip would likely pay more for the trip than just the travel costs to Grand Canyon in order to enjoy a 2-week float trip. This extra value or consumer surplus realized on these trips may be influenced by the river flows, as minimal flows will reduce the size of some rapids, as well as the time available for stopping at side canyons and visiting cultural sites.

Local Economic Effects of Visitor Spending

While visitor expenditures are a cost to the visitor, they create positive, direct economic effects in the local area in the form of additional income and employment in the retail sector. The ripple, or multiplier effects, of such spending reverberates to the wholesale and distribution sectors that supply the retail sector. This second round of economic stimulation is known as indirect effects. Further, a portion of the money received by employees as wages and profits to business owners gets respent in the local economy on other consumer goods and services. These respent portions are often referred to as induced effects. The regional multiplier is the sum of these direct, indirect, and induced effects divided by the direct effect (Douglas and Harpman, 1995; Loomis and Walsh, 1997; Minnesota Implan Group, 1997). Thus, the local economic effects of recreation include employment and income that originate from the economic sectors directly catering to tourists but also include many other sectors indirectly affected by recreation spending.

Nonuse Values

Nonuse values include the benefits that people derive from simply knowing that a unique and irreplaceable natural environment or species exists even if the individual does not visit it or see it. This component of nonuse value is often called "existence value." Nonuse values also include a bequest value from knowing that protection today provides the unique natural resources to future generations. The unique natural environment of Grand Canyon was used as an example in the seminal article on existence value by Krutilla (1967, p. 778). Krutilla also noted that continued existence of a threatened and endangered species (e.g., humpback chub (*Gila cypha*)) would also generate existence values.

The U.S. Department of the Interior officially recognized existence values in 1986 when it included these values in procedures to calculate natural resource damages from hazardous substances (U.S. Department of the Interior, 1986). The inclusion of nonuse values was broadened by the U.S. District Court of Appeals decision (1989), which referred to nonuse values as passive-use values, and indicated that both use and passive-use values must be considered when performing a natural resource damage assessment. The concept of

nonuse values and its empirical measurement by using surveys were given a qualified endorsement by a blue ribbon panel commissioned by the National Oceanic and Atmospheric Administration and chaired by two Nobel laureates (Arrow and others, 1993). The potential role of nonuse values in policy analysis for the Glen Canyon Environmental Studies program is discussed in Harpman and others (1993). The growing acceptance of including nonuse values in valuation of ecosystems is evident in the latest National Research Council (2005, p. 6) report, which states, "economic valuation of changes in ecosystem services should be based on . . . both use and nonuse values."

Of course, what is relevant for this chapter is how the nonuse values of Grand Canyon change with alternative dam operations that affect the native species in Grand Canyon for current and future generations. We will discuss the one study, performed in 1994, that measured nonuse values for changes in natural resources in Grand Canyon (Welsh and others, 1995). Unfortunately, there have been no follow-up studies to measure how nonuse values have changed as a result of stabilization of river flows, beach building, and recovery efforts for the humpback chub.

Empirical Measurement of Use and Nonuse Values

Recreation Use Values

To estimate visitor benefits or consumer surplus, there are two broad categories of methods: (1) those that rely upon actual behavior or what are called "revealed preference methods" and (2) those that rely upon intended behavior or what are called "stated preference methods." The travel cost method (TCM) for estimating recreation demand is an example of a commonly used revealed preference method. The basic TCM uses variations in visitors' travel costs as a proxy for the price of a trip and the number of trips taken as a measure of quantity to trace out a demand curve for recreation at the particular site. From the demand curve, the consumer surplus or net willingness to pay (WTP) can be measured (Loomis and Walsh, 1997). More recent TCM models involve a random utility model of site choice to reveal the net WTP of visitors for access to a recreation site.

Within stated preference methods is the frequently used contingent valuation method (CVM), as well as newer conjoint and choice experiment techniques. These stated preference methods use a survey to construct a simulated or hypothetical market in which an individual's consumer surplus is elicited. For example, the analyst often asks a visitor what is the maximum increase they would pay to visit a particular site. In most of the CVM studies reviewed below, a popular willingness-to-pay question format, called "dichotomous choice," is used. In this question format, individuals are asked if they would pay a higher trip cost of $X. The amount of $X varies across the sample. At higher dollar amounts, a lower percentage of visitors would pay that amount, and conversely at lower dollar amounts, a higher percentage would pay that amount. By plotting the percentage of people who would pay each dollar amount, a demand-like relationship is traced out from which consumer surplus can be calculated. Conjoint and choice experiments also use a survey to present alternative trips with different levels of trip characteristics (e.g., flow levels, size of beaches) to directly estimate how consumer surplus changes with changes in trip characteristics.

Both methods, the TCM and CVM, are recommended for use by Federal agencies such as the Bureau of Reclamation for valuing recreation (U.S. Water Resources Council, 1983). There have been hundreds of applications of both methods worldwide. Extensive comparison of the consumer surplus estimated by using the TCM and CVM suggests that the two have convergent validity, as estimates of consumer surplus by the two approaches are nearly identical and are highly correlated with each other (Carson and others, 1996).

Measurement of Regional Economic Effects of Recreation

To calculate the local economic impacts associated with visitor expenditures, an input-output model is used to calculate the multiplier effects (Douglas and Harpman, 1995; Loomis, 2002). The general economic approach of combining expenditure data with an input-output model is called "regional economic analysis" because it usually measures the effect on a local economy (county) or a region (group of counties). The input-output model translates the visitor expenditures into total local income and employment. The regional economic analyses reported in this chapter use IMPLAN® software (Minnesota Implan Group, 1997)

to construct an input-output model of the local region. The input-output model captures the ripple, or multiplier effects, of the direct spending on indirect spending of related industries and induced spending of workers receiving additional wages.

Measurement of Nonuse Values

Stated preference methods such as the CVM or conjoint/choice experiments are the only methods currently available for measuring nonuse values. Much like the recreation application of the CVM, the application of these methods to measure the willingness of a consumer to pay for nonuse values involves using a survey to construct a simulated or hypothetical market or referendum. In this case, however, a random sample of households is interviewed or mailed a survey. They are asked whether they would vote in favor of or against a particular management action or program involving protection of the resource at a specific cost to their household in the form of higher taxes or prices.

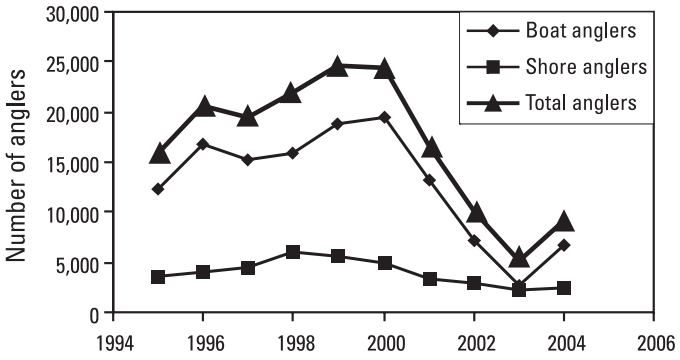

Figure 1. Angler use at Lees Ferry, 1995–2004 (developed from data found at http://www2.nature.nps.gov/mpur/ for Glen Canyon National Recreation Area).

Status, Trends, and Recent Findings

Recreation Use Values of Glen Canyon

Fishing Use

Because of the clear, cold water released from Glen Canyon Dam, the 15-mi (24-km) stretch of the Colorado River below the dam provides a significant trout fishery in Arizona. As shown in figure 1, use has fluctuated over the past 10 yr. In part, fluctuating use may be due to increasing populations of trout reaching carrying capacity of the stream, which results in a reduction of the size of fish from their earlier trophy size. Changes in fishing regulations (including greater restrictions in permissible fishing gear and reductions in catch limits) may also be partially responsible for fluctuating use patterns. Shore anglers are less affected than boat anglers because there are threshold minimum flows for floating the boats over the rocks in critical reaches. The downturn in Lees Ferry angler use may be due to a variety of factors and, therefore, suggests the need for an integrated multivariate statistical analysis of the relationship between angler use, catch-per-unit effort, and fish size. Chapter 2 of this report presents a catch-per-unit effort that suggests that the decline in angler days may be due to decreasing angler catch rate, which fell from a peak of nearly 1.5 fish per hour in the 1998–99 time period to 0.5 fish per hour in 2002. At the same time, the size of fish continued to decrease through 2001.

Fishing Values

There are only two economic valuation studies of recreational fishing in the Lees Ferry reach, both of which are fairly old. The first study was by Richards and others (1985) and used the TCM to estimate the consumer surplus of trophy trout anglers and nontrophy trout anglers. The authors calculated net willingness to pay over and above their trip cost of $381 for trophy trout anglers and $272 for nontrophy trout anglers. Using the percentages of trophy and nontrophy anglers that existed at the time of the study (now more than 20 yr ago, and before the change in fishing regulations), the weighted average value was $304 in 1983 dollars. In 2004 dollars, the consumer surplus is $580 per trip.

The second study, and the only one we are aware of that related angler value to river flow levels, was conducted by Bishop and others (1987). During 1985, anglers were sampled at Lees Ferry. The investigators used a dichotomous choice, willingness-to-pay format in their CVM survey of anglers. The net willingness to pay for the anglers' actual trips ranged between $130 for those experiencing constant flows and $104 for those experiencing fluctuating flows. In 2004 dollars this is

about $250 per trip for those experiencing constant flows and nearly $200 for those experiencing fluctuating flows.

While the 20%–25% difference in value per trip with constant versus fluctuating flows gives some insight into the effect of Glen Canyon Dam operations on the value of fishing, the study by Bishop and others (1987) also asked anglers their net willingness to pay for a wide range of flow scenarios. The results indicated that angler benefits (WTP) peaked at a flow of 10,000 cubic feet per second (cfs) with constant flows at $126 per trip ($240 in 2004 dollars). This finding is in the same range of benefits as the actual trip experience, where 75% of anglers experienced a flow between 5,000 and 15,000 cfs on their most recent trip (Bishop and others, 1987, p. 121). At low flows, such as 3,000 cfs, the values per trip fell to half at $60 per trip ($114 in 2004 dollars). At high flows of 25,000 cfs, the value per trip was $94 ($178 in 2004 dollars). Thus, there is a nonlinear relationship between angler benefits and flows.

Combining the values per angler trip and the number of anglers yields estimates of annual recreational fishing benefits that range from $2.4 to $4.8 million (2004 dollars) at optimum flow levels, corresponding to the range of past use of 10,000 to 20,000 angler days. At low flows these values drop by more than half to $1.1 million to $2.3 million annually.

While these values suggest that the recent flow experiments such as the low summer steady flows (LSSF) in 2000, which held flows steady at 8,000 cfs, probably did not result in a large reduction in angler benefits from optimum flows, it is not possible to know for sure without conducting surveys of anglers during this period. Judging solely by angler use levels, the LSSF was associated with angler use equivalent to the previous year (1999). This is corroborated by the findings of Hjerpe and Kim (2003), who interviewed fishing guides and found that the 2000 season had slightly higher angler use but in line with the growth in angler use in the past 5 yr.

Day-use Rafting

The 15 RM of Glen Canyon below the dam provide an opportunity for scenic day-use rafting. At low to moderate river flows, the half-day raft trips launch below Glen Canyon Dam and float downstream to Lees Ferry (Douglas and Harpman, 1995). At very high flows or at times when the national security level reaches red and visitors are not allowed to launch from the dam, they must launch from Lees Ferry and motor most of the way upstream and then float down. As is shown in figure 2, this is a popular float trip, averaging around 40,000 visitors each year.

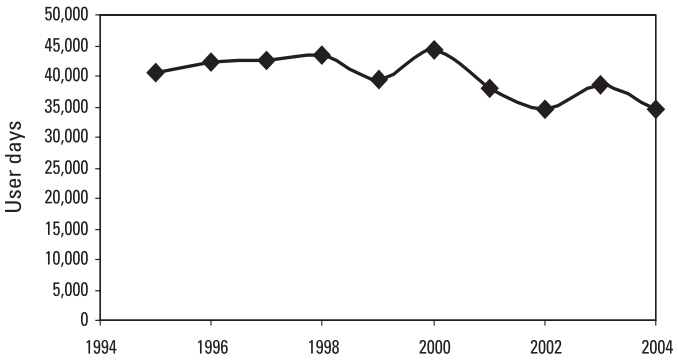

Figure 2. User days per year at Glen Canyon National Recreation Area for day-use rafting, 1995–2004 (source: fax from Jacki Blais, Glen Canyon National Recreation Area, to Lara Schmit, U.S. Geological Survey, January 12, 2005).

Economic Values of Day-use Rafting

The only study of the economic value of day-use rafting was performed nearly 20 yr ago in 1986 by Bishop and others (1987). About half of their sample were rafters starting their trips below Glen Canyon Dam and then floating down, and the other half were motoring up and then floating down. Dichotomous choice CVM was used to estimate the consumer surplus that day-use rafters received. Statistical tests indicated that the WTP functions were not statistically different between the rafters starting their float trip below the dam and those who motored up and then floated down (Bishop and others, 1987, p. 145). Overall, the net WTP or consumer surplus was $26 per day, or nearly $50 in 2004 dollars. These figures translate into an annual value of $2 million.

Based on the attribute survey and the lack of difference in WTP values for the two departure locations, Bishop and others (1987, p. 145–146) concluded that day-use rafting trip values were not sensitive to river flow. This insensitivity to flows may be because visitors lacked prior knowledge regarding river flows and because of the lack of rapids in this section of the river. Obviously, it would be desirable to update these values, especially with the new flow regimes since 1986, and revisit the Bishop and others (1987) finding of no apparent relationship between flow and recreation benefits for the day-use rafting.

Recreational Rafting Use of Grand Canyon

Grand Canyon National Park is world renowned for its whitewater rafting opportunities (Behan, 2000). Typically, commercial motorized rafting trips navigate the entire 226 RM from Lees Ferry to Diamond Creek (one of the takeout points) in 1 week, although there are also 2-week commercial oar trips. Private boaters typically take about 18 d for this same trip (Hjerpe and Kim, 2003). Passengers of commercial trips and some private oar trips navigate the river either from Lees Ferry to Phantom Ranch (88 RM) or meet their trip at Phantom Ranch and end at Diamond Creek.

The popularity of rafting in Grand Canyon skyrocketed during the late 1960s and 1970s, prompting the National Park Service to place limits on the number of commercial and private boaters. During the 1970s to 1990s, 21 commercial rafting companies took visitors down Grand Canyon. Today, the limits are 115,000 user days for commercial rafting companies and about 55,000 for noncommercial, or private, users. The binding nature of these limits on use can be seen in figure 3.

The number of user days, however, masks the large difference in the number of passengers permitted for the two groups. Since the private trips are often much longer than commercial trips, there are nearly six times the number of commercial passengers (18,500–19,600) as there are noncommercial passengers (3,400–3,600).

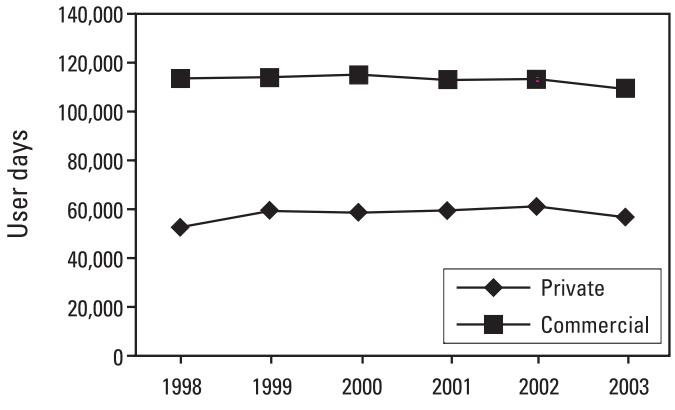

Figure 3. Number of private and commercial boater user days, Grand Canyon National Park, 1998–2003 (source: www.nps.gov/grca/crmp/documents/stats/1998-2003ByMonth.pdf).

Over time the demand for private trips has increased substantially relative to commercial trips. This increase has resulted in a substantial and growing wait to obtain a private permit. The wait has grown from about 5 yr in 1991 to 12 yr in 2003, resulting in the National Park Service revisiting its allocation by issuing in October 2004 the Draft Environmental Impact Statement Colorado River Management Plan. The preferred alternative in the management plan nearly doubles the noncommercial user days and the number of private passengers permitted (Grand Canyon National Park, 2004).

Because of excess demand and user limits, one cannot cite visitor use as an indicator of visitor response to alternative flow regimes (Hjerpe and Kim, 2003). Rather, one must conduct surveys to ascertain how visitor experience and economic benefits (i.e., consumer surplus) change with alternative flow regimes and natural resource conditions.

There are two surveys that provide some insights into how visitor satisfaction in nonmonetary terms varies with flow levels. The first survey was performed as part of the original Glen Canyon Environmental Studies program during 1984 and 1985 by Bishop and others (1987). Surveys of river guides, private trip leaders, commercial passengers, and private rafters found that constant flows in the range of 20,000–25,000 cfs yielded the highest satisfaction ratings. In essence, flows in this range allowed for larger rapids, more time for stopping at side canyons and attraction sites, and less time motoring or rowing. Low flow levels frequently resulted in visitors having to walk around certain rapids, which decreased trip satisfaction.

The second survey was by Stewart and others (2000), who during 1998 and 1999 replicated the portion of the Bishop and others (1987) study that dealt with whitewater rafting trips. This more recent study found the same pattern of visitor satisfaction ratings with regard to flow. In particular, the study found that whitewater rafting satisfaction was highest at constant flows of 20,000–25,000 cfs and that several flow-related trip characteristics such as large rapids and time to stop and hike the side canyons were highly important (Stewart and others, 2000). This study also found that large beaches with shade from trees for stopping and camping was rated as moderately important.

Related to these satisfaction surveys are trip diary data collected by Roberts and others (2002) and Roberts and Bieri (2001) to develop a Grand Canyon river trip simulator. In their simulation model, river flows are a key determinant of boat speed and, hence, the amount of time for trip-related activities such as swimming, visiting cultural sites, hiking, campsite selection, and decisions to

layover part of or an entire day. Roberts and Bieri (2001) also used trip diaries to study the LSSF of 2000. They found that the low flows reduced the amount of time visitors had for swimming, hiking, and visiting cultural sites from 7 h/d on a typical trip (flow averaging 19,000 cfs) to 3.5 h with the 8,000 cfs of the LSSF. Thus, with the 8,000-cfs flows, an additional 3.5 h/d were spent motoring or rowing to make up for lost time because of the slower flows (Roberts and Bieri, 2001, p. 13).

Economic Values of Private and Commercial Rafting in Grand Canyon

The price of a commercial Grand Canyon rafting trip is substantial, averaging around $215 per person per day (Hjerpe and Kim, 2003). For private trips, the National Park Service requires a $100 payment to get on the waiting list, coupled with a payment of $100 for every person taking the trip (Hjerpe and Kim, 2003). One way to think of the $100 payment to get on the waiting list is as an "option value," a willingness to pay to maintain the opportunity to raft Grand Canyon in the future.

The payment of commercial fees and related visitor expenditures of commercial and private rafters creates significant positive economic effects in the region in the form of income and employment. These effects are detailed in the regional economic effects section of this chapter.

Our interest here is the amount of benefits received by the whitewater rafters and kayakers themselves. This is their net economic value, or consumer surplus. The first and only primary data study on whitewater rafting economic values and how they change with flow was conducted by Bishop and others in 1987 (see also Boyle and others, 1993). These authors used a dichotomous choice CVM survey of commercial and private boaters. They found that commercial passengers' willingness to pay for their actual trip experience rose from $127 ($228 in 2004 dollars) at 5,000 cfs to a maximum value of $888 ($1,598 in 2004 dollars) at higher flows and then declined only slightly at 40,000 cfs (Boyle and others, 1993). For private boaters the value of their actual trips rose from $111 ($200 in 2004 dollars) at 5,000 cfs to a maximum of $637 ($1,147 in 2004 dollars) at 28,000 cfs. This value falls to $455 ($819 in 2004 dollars) at 40,000 cfs (Boyle and others, 1993). The larger decline in value at the highest flows is likely because of less experienced private trip leaders compared with professional guides on commercial trips. Nonetheless, these are very high recreation trip values, although less dramatic on a per-day basis (about 7 d for a commercial trip). The relatively high value is commensurate with the high-quality experience and high satisfaction received by the majority of visitors to Grand Canyon.

Summing these updated 2004 dollar values over the nearly 19,000 commercial passengers and 3,500 private boaters, these values at optimum flows are $30 million and $4 million annually in economic value to commercial passengers and private boaters, respectively. Based on Bishop and others (1987), there would be a drop in total whitewater rafting benefits from $34 million to $5 million, or a loss of $29 million, at low flows such as 5,000 cfs (a flow level close to the LSSF of 2000). Unfortunately, the opportunity to evaluate the actual loss in recreation benefits with the LSSF was missed.

There is only one more recent estimate of whitewater river recreation in Grand Canyon that has been made. Hammer (2001) used the TCM with travel costs calculated by using the U.S. Postal Service ZIP Code™ data from the 1998 recreation preference surveys of Hall and Shelby (2000) and Stewart and others (2000). Since these surveys were not originally designed for economic analysis, however, they do not allow for analysis of how the economic value of the rafting trips changes with flow levels. Nonetheless, Hammer (2001) did a very careful job of using ZIP Codes to calculate travel costs of visitors and using this information to estimate a TCM demand curve. This calculation is somewhat challenging because each visitor usually takes just one trip. But by using a zonal or visits-per-capita type demand model, Hammer (2001) was able to calculate an estimate of the value in 1998–99. The value per trip for private boaters was $134 or ($148 in 2004 dollars) and $314 ($351 in 2004 dollars) for commercial trip passengers (Hammer, 2001).

The inability to link recreation benefits from Hammer's (2001) study to flows is unfortunate. If there is an insufficient budget to fund separate recreation eco-

nomic surveys, then an integrated social science survey that would allow for data to provide both preference and valuation in relation to flows would be desirable. Such recreation valuation monitoring should be planned into future flow experiments.

Regional Economic Effects of Water-based Recreation in Glen and Grand Canyons

As discussed previously, recreational fishing and rafting involve tens of thousands of visitors each year to the Glen Canyon and Grand Canyon areas. Commercial rafting on Grand Canyon currently involves 16 different companies. One of these companies also provides day-use rafting in Glen Canyon, and there are support companies providing visitor and shuttle transportation to day-use rafters. Many anglers in Glen Canyon also employ professional fishing guides, who often use boats for guiding. Even the anglers and private rafters who do not use commercial outfitters spend a significant amount of money in the local areas on hotels, restaurants, groceries, ice, gasoline, and supplies.

The local economic effects of recreation on the retail, supporting wholesale, and distribution sectors and on induced spending elsewhere in the economy from river-based recreation expenditures have been calculated in two studies. The most comprehensive regional economics study was by Douglas and Harpman (1995), who used data collected in 1985. Table 1 presents the average trip expenditures, total trip expenditures, the amount spent in the local region (defined by Douglas and Harpman as Coconino County, where Page, Arizona, is located, and Mohave County), and the resulting total employment. The employment effects reflect only visitor spending in the region, and the multiplier effects are calculated by using IMPLAN® (see Douglas and Harpman, 1995). The monetary amounts used in Douglas and Harpman (1995) have been updated to 2004 dollars, but the employment estimates are calculated directly from their data (see Douglas and Harpman, 1995, tables 3 and 6 using 1990 relationships) and are consistent with calculations developed by Douglas (2005) of 438 total jobs in whitewater boating in Grand Canyon National Park.

As indicated in table 1, the total of nearly 600 jobs provided by river-based recreation is a substantial number of jobs. Commercial rafting, particularly the Grand Canyon National Park segment, contributes the majority of the jobs, 438.

Unfortunately, there has been little systematic comprehensive research that links changes in flows to angler use or other visitor use and, hence, to associated changes in economic impacts. There has been one study on the effect of the lower summer steady flows on economic impacts to the rafting and angling outfitters by Hjerpe and Kim (2003). They found that these low flows had minor effects, mostly related to damage to equipment in Grand Canyon and angler boats in Glen Canyon. Day-use rafters in the Glen Canyon reach were apparently not affected (Hjerpe and Kim, 2003). The direct economic consequences of higher outfitter costs because of commercial boat damage were in the range of $25,000, and the loss in fishing guide services during the spike flows that were part of LSSF was in the range of $33,000 (Hjerpe and Kim, 2003). As the result of low flows stranding commercial whitewater trips, there were also three rescue operations, which cost $30,000. Hjerpe and Kim (2003) aggregated these as losses to Coconino County for the regional economic analysis. The IMPLAN® estimated total effects on Coconino County were $117,705 in losses. This estimated total is relatively minor to the local economy; however, Hjerpe and Kim (2003) acknowledged that they may have mixed local economic losses from reduced fishing guide income with increases in economic activity from boat repair and helicopter rescue. There is a problem with using regional economic impact analysis as an indicator of the economic effects of changes in flows: higher outfitter expenses, which are costs, have the potential to actually increase economic activity. Thus, a benefit-cost analysis that would treat higher costs to outfitters as the actual losses that they are to society would probably be more appropriate for monitoring the economic consequences of changes in the flow regime.

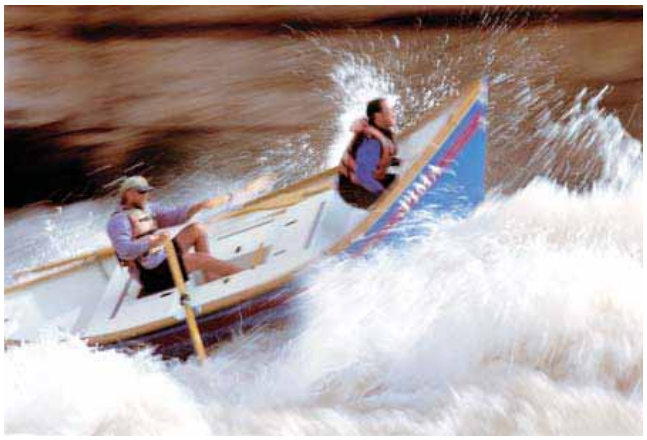

Table 1. Local economic effects of river recreation in northern Arizona (2004 dollars).

[Source: Douglas and Harpman (1995). The monetary amounts used in Douglas and Harpman (1995) have been updated to 2004 dollars, but the employment estimates are calculated directly from their data]

	Glen Canyon National Recreation Area		Grand Canyon National Park		Total
	Day -use rafting	Anglers	Commercial rafting	Private rafting	
Average trip expenditures	$115.90	$355.91	$2,711.30	$981.84	
Nonresident total expenditures	$3,803,374	$3,655,174	$36,542,901	$2,872,876	$46,874,326
Nonresident total expenditures in region	$3,803,374	$1,810,320	$15,351,554	$1,195,997	$22,161,245
Total jobs	100	48	406	32	586

The comparison of these relatively minor local economic effects from the LSSF illustrates the limitation of relying on regional economic analyses: if visitor use does not change much because of the National Park Service limits on passenger days, then the effects of river flow will not be manifested in changes in regional economic effects (Hjerpe and Kim, 2003). Rather, any effects of river flow changes are more likely to be manifested as changes in user satisfaction and use value. Without conducting a valuation survey, the most likely economic effects of changes in river flow regimes in Grand Canyon may be missed.

Nonuse Values

As noted above, Grand Canyon is also a source of nonuse or existence/bequest values to people who may never or no longer visit Grand Canyon (Harpman and others, 1993). The same is true with the continued existence of endangered species, such as the humpback chub, in their natural habitat. A given household's nonuse values for improving river flow management in Glen Canyon and Grand Canyon can be obtained by using the CVM. To date, there has been only one nonuse CVM survey that asked willingness to pay to improve native vegetation (and associated birds and other wildlife), native fishes, game fish (such as trout), river recreation, and cultural sites in Glen Canyon National Recreation Area downstream of Glen Canyon Dam and in Grand Canyon National Park. This study was conducted in late 1994 and early 1995 by Welsh and others (1995).

There were two main sampling strata in the Welsh and others (1995) study: a sample called market area, reflecting Western U.S. households receiving hydropower from Glen Canyon Dam, and then a national sample, reflecting the rest of the Nation. These sampling strata received different payment vehicles: the market area would pay for protection via higher utility bills, while the national sample would pay via higher taxes. There were three main river-flow scenarios and accompanying changes in five main environmental attributes (beaches, risk of erosion to cultural sites, vegetation/bird habitat, native fish, and trout). At the time the survey was conducted, the main flow regimes under consideration involved degrees by which the fluctuating flows previously associated with peaking power production would be moderated. The three main flow scenarios were (1) moderate fluctuating flows, (2) low fluctuating flows, and (3) seasonally adjusted steady flows. While all scenarios would maintain beaches at current conditions, decrease the erosion risk to cultural sites substantially, and increase streamside vegetation by 10%, the steady flow scenario was described as providing improvements for native fish and trout.

The response rates in the two sample strata were quite high by comparison to most CVM studies in the literature. The national sample had an overall response rate of 74%, and the marketing area sample had a response rate of 83% (Welsh and others, 1995).

To provide a conservative estimate of nonuse values, only those responses that indicated "definitely yes" as yes responses to the dichotomous choice CVM responses were counted and yielded the values per household shown in table 2. Counting only "definitely yes" responses has been shown in actual cash validity test comparisons to yield a valid measure of actual cash willingness to pay (Champ and others, 1997; Ethier and others, 2000).

The steady flow scenario, which was supposed to be the most beneficial for fish, had the highest willingness to pay, especially by households living closest to Grand Canyon (i.e., the market area sample strata). The annual per-household willingness-to-pay values are quite reasonable and, yet, when aggregated up to the number of households in the population, produce estimates in the $3 billion to $4 billion range. Thus, the nonexcludable and nonrival nature of protection of the Grand Canyon environment is evident in the fact that modest willingness to pay per household across the country adds up to a substantial total. In some sense this response is not unusual; after all, Grand Canyon is a national park and Glen Canyon a national recreation area. In fact, Grand Canyon was designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a World Heritage Site in 1979, suggesting that limiting the aggregation of benefits to just U.S. households probably significantly understates the total economic value received from Grand Canyon by people around the world.

This survey is now nearly 10 yr old, and much has been learned in that decade about the response of the Grand Canyon environment to changes in flow regime, including the decreasing trends in humpback chub populations. Several of the ecological responses to moderate or steady flows described in the survey, while based on the best available science at the time, have not been fully realized. As the name "contingent valuation method survey" suggests, the values obtained from such a survey are contingent upon the description of the environmental effects. Since the actual and anticipated environmental effects associated with different flow regimes are somewhat different from those envisioned at the time of survey, it may be appropriate to update the nonuse value survey to more current ecological estimates that are associated with different flow regimes. The facts that the alternative flow regimes currently being implemented are somewhat different from those described in the survey and that quite different management actions, such as temperature control devices, are being considered suggest that to keep nonuse valuations current, it would be worthwhile to update this survey. The National Park Service Organic Act of 1916 has been interpreted as a dual mandate of recreation and preservation of the national parks (Loomis, 2002). This dual mandate suggests that it is insufficient to only measure economic values of a national park by recreation use value. More recent legislation such as the Redwoods Act—as amended in 1978 to the General Authorities Act of 1970 (16.U.S.C. 1a-1), which governs the National Park Service—provides that, when there is a conflict between recreation use and preserving the parks unimpaired, preservation is the primary objective. The preservation value of a national park, therefore, is also reflected in its nonuse values. As suggested previously by the National Research Council (1999), these nonuse values reflect values to nonrecreation stakeholders and should be used by managers in decisionmaking.

Discussion and Future Research Needs

Based on past studies, it appears that economic values for natural and cultural resources in Grand Canyon and Glen Canyon amount to nearly $40 million of use values and several billion dollars worth of nonuse values each year. With 12-yr waiting lists to raft Grand Canyon National Park and tens of thousands of anglers and boaters using Glen Canyon National Recreation Area each year, recreation is obviously an important public use of these two areas. The now nearly 10-yr-old study

Table 2. Estimates of nonuse value for three flow scenarios (2004 dollars) (updated from Welsh and others, 1995).

	National sample		Market area sample	
Flow scenario	**Per household**	**Annual value (millions)**	**Per household**	**Annual value (millions)**
Moderate fluctuations	$17.06	$2,858	$27.94	$79
Low fluctuations	$25.19	$4,219	$27.17	$77
Steady flow	$25.69	$4,303	$36.57	$103

suggested that preservation of natural environments in Grand Canyon provides nonuse values (e.g., existence and bequest values) to citizens nationwide. Given that nonuse values are nonrival goods available to all, the rapid population growth in the Southwestern United States suggests that nonuse values have probably risen substantially as well.

Unfortunately, studies of the recreation and nonuse values are between 10 and 20 yr old and reflect the flow regimes in place before the Grand Canyon Protection Act of 1992. Recreation use values and nonuse values in the current flow regime and how they change with experimental flow regimes have not been studied. With proposed increases in whitewater rafting use levels in Grand Canyon National Park, it is time to begin regularly monitoring recreation satisfaction and use value. The Grand Canyon Protection Act specifically lists recreation monitoring, and the omission of systematic recreation use value monitoring has been previously pointed out by the National Research Council (1999). Behan (2000) provided detailed suggestions on the type of recreation monitoring that is needed. If the spirit of adaptive management and the function of the Grand Canyon Monitoring and Research Center are to be more fully realized, the call in the Grand Canyon Protection Act of 1992 to monitor recreation needs to be given the same consideration that has been given to other resources discussed in this report. If integrated adaptive management of all resources is to be performed, then it is important to monitor recreation satisfaction and value since recreation is directly affected by flow regimes, changes in sand deposits for beaches, and trout size and abundance. For example, a better understanding of changes in angler use in Lees Ferry could result from an integrated analysis of use in relation to catch rate and fish condition class.

The importance of recreation use and nonuse values is becoming more apparent as trade-offs are explored between desired flows to recover endangered humpback chub and those desired for recreation and hydropower. Although the Endangered Species Act of 1973 requires that all reasonable and prudent recovery alternatives be considered, having economic valuation information on recreation, endangered fish, and hydropower may aid in finding a suitable balance. Federal oversight agencies such as the Office of Management and Budget may require benefit-cost information on temperature control devices being considered at Glen Canyon Dam to aid recovery of humpback chub. Adaptive management requires putting monitoring in place prior to new management actions. Now is the time to do the same for recreation use economic values so that the intended and unintended effects of future management actions can be assessed.

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