Economic Impacts of Low Summer Steady Flows on Recreation

Evan Hjerpe and Yeon-Su Kim

PO Box 15018, School of Forestry
Northern Arizona University, Flagstaff, AZ 86011

Abstract

The purpose of this study is to understand how variable flows of the Colorado River affect the economic operations of recreation-based industries, and their extended effects on the regional economy. The investigation is focused on changes in economic impacts due to the Low Summer Steady Flows (LSSF) of the Colorado River on private whitewater boaters, anglers, and river concessionaires. Concessionaires reported that economic impacts during LSSF differed significantly than under normal daily operations. Aggregated LSSF-related expenses incurred by rafting concessionaires totaled over $70,000 (based on personal interviews and mail surveys). Angling concessionaires benefited slightly from improved fishing, but the summer's rise in overall trips was proportional to increased growth for the past five years. However, during the two spike flows angling concessionaires reported a loss of $33,000 (based on interviews and surveys), due to the inability to conduct trips. Economic impacts to private boaters and anglers did not differ significantly during the LSSF. Private boaters are better suited for lower flows because they typically use smaller boats. Both private anglers and boaters experienced a few equipment- damaging incidents, but increased interest in lower flows offset any negative economic impacts. Spike flows, slower rafting trips, and the relative inflexibility of large commercial boats, all add to new understandings of the recreation-based economies dependent on the existing ecosystem. The regional economic impacts were further analyzed with Impact Analysis for Planning (IMPLAN) computer software.

Introduction

The protection and management of rivers frequently visited for outdoor recreation often leaves local residents concerned that local economic growth and opportunities could be adversely affected. Previous studies have shown that recreational rivers have

positive economic effects on local regions and can provide an environmentally friendly impetus to a stagnant economic base (Cordell *et al.*, 1990; English and Bowker, 1996). Such is the case with the stretch of the Colorado River running through Glen Canyon Recreational Area and Grand Canyon National Park. With the inception of Glen Canyon Dam in 1964, two main recreational activities of angling and rafting were able to flourish on the "new" Colorado River. Dam-controlled releases varied from 3,000 cfs to 40,000 cfs, with typical fluctuations ranging between 10,000 cfs and 25,000 cfs. In the summer of water year 2000, the Bureau of Reclamation conducted an experimental low summer steady flow (LSSF) of 8,000 cfs. Earlier drought conditions allowed the Bureau to see if an LSSF would facilitate the breeding of endangered native fish in the Colorado. The LSSF also included two four-day spike flows of 31,000 cfs.

Water rights and flow levels are of the utmost importance in the Southwest. The amount of water (in cubic feet per second) released from Glen Canyon Dam is dependent on current energy needs and in-stream flow levels from the upper Colorado River into Lake Powell. Higher releases of water result in greater energy-producing capabilities, and vice versa. Recent Californian energy shortages indicate that the Colorado River and other Western rivers will be subjected to various flow patterns in search of optimizing hydropower efficiency. Meeting these current and future energy needs will certainly affect the flow regime out of Glen Canyon Dam. Having baseline information on how river recreation is affected by the different flow patterns will allow land managers and park officials to make well-informed decisions.

The purpose of this study is to understand the direct economic impacts on recreation associated with different flow levels of the Colorado River, and their extended effects on the regional economy. Furthermore, the investigation is focused on changes in economic impacts due to the Low Summer Steady Flow on private whitewater boaters, anglers, and river concessionaires. There are two hypotheses being tested: (H_1)--economic impacts to whitewater and angling concessionaires will not differ

significantly from economic impacts under normal daily operations; and (H_2)--economic impacts to private whitewater boaters and anglers will not differ significantly from economic impacts under normal daily operations.

There have been several studies documenting preferences (including flow-levels) of Colorado River recreationists (Bishop *et al.*, 1987; Hall and Shelby, 2000; Stewart *et al.,* 2000). There have also been several economic studies on river recreation and the benefits of recreation in rural economies (Bergstrom *et al.,*1990; Douglas and Harpman, 1995; Johnson and Moore, 1993). Of the economic studies, Douglas and Harpman (1995) is the only analysis of economic effects of river recreation in the Glen Canyon Dam region. Their research examined regional employment effects of recreation expenditures at Lee's Ferry on the Colorado River. While angling was included, the majority of recreation expenditures were the result of white-water rafting. The study showed that total annual expenditures for trips to Lee's Ferry were $14,167,847, in 1990 dollars. The economic modeling software IMPLAN (Impact Analysis for Planning model) was used to estimate regional employment impacts from these expenditures at 586 jobs. Their study concluded that employment levels did not vary significantly with flow regime. Bishop *et al.* (1987) determined that the benefits of day-use rafting are also not sensitive to flow levels. Stewart *et al.* (2000) used on-site interviews of recreationists to do follow-up research on the findings of the Bishop study. The findings of both studies were very similar, and showed that Grand Canyon boaters preferred a water release of 25,000-30,000 cfs. On the other hand, anglers preferred a constant flow of around 10,000 cfs. While preferences cannot be directly translated into economic impacts, some of the survey results held foreboding implications for the LSSF in water year 2000. A survey of river guides in both 1987 and 1998 asked for the minimum flow level for running the river safely with passengers. The mean minimum flow was right above 8,000 cfs on both surveys. Moreover, the river guides were asked which rapids or sites would be the most problematic below the minimum safety level.

The top three mentioned problematic spots were Hance Rapid, Horn Rapid, and Crystal Rapid (Stewart *et al.,* 2000). Among many minor incidents, the LSSF was also blamed for three major boating accidents, all of which required helicopter evacuations. These three incidents occurred at Hance, Horn, and Crystal rapids.

The LSSF study is the first study assessing the economic impacts of a particular flow level on Colorado River recreation. Economic impacts were assessed by comparing data gathered by personal interviews and mail surveys with overall industry totals and running the direct impacts through IMPLAN's regional impact analysis. The LSSF of water year 2000 did have economic ramifications for the boating and angling concessionaires. The aggregated LSSF-related expenses incurred by rafting concessionaires totaled over $70,000. The majority of economic impacts were the result of boat and motor damage caused by newly exposed rocks. Angling concessionaires benefited slightly from improved fishing, but the subsequent rise in overall trips was proportional to increased growth for the past five years. However, during the two spike flows (in early May and late September) angling concessionaires reported a loss of $33,000, due to the inability to conduct trips. The economic impacts to private boaters and anglers did not differ significantly during the LSSF. Both private anglers and boaters experienced a few equipment-damaging incidents, but increased interest in lower flows negated any negative economic impacts. The results affect our current understandings of the Grand Canyon ecosystem by indicating that the relative inflexibility of large, commercial boat trips makes them more susceptible to accidents at such low flows. Results also indicate that angling concessionaires will not conduct trips during spike flows, and therefore, are more sensitive to high flows.

Colorado River Recreation Background

Rafting

There are three methods of rafting the Colorado River. Commercial rafters typically take seven to fourteen days to navigate sections and/or the entire Grand

Canyon. Many customers will either hike in or out of the canyon enabling them to raft certain sections. Private boaters typically take about 18 days to boat the entire canyon to Diamond Creek. Commercial day-use rafters spend a day boating from Glen Canyon Dam down to Lee's Ferry. Tours of this 15-mile stretch of river are available from only one concessionaire (Wilderness River Adventures). Because of national park status and an incredibly high demand, all trips below Lee's Ferry are heavily regulated. Commercial concessionaires are allotted 115,500 user days, while private boaters are allotted 54,450 user days a year. Day-use rafting in Glen Canyon Recreation Area does not have established limits. Commercial passengers pay an average of $215 a day for trips in the Grand Canyon, and according to the Grand Canyon River Outfitters Association (GCROA) this activity generates approximately $28 million of gross income for outfitters (Grisham of GCROA, 2001 personal communication). Grand Canyon National Park requires private trip leaders to pay $100 to get on the waiting list, and then another $100 for every person taking the trip. The Grand Canyon National Park waiting list for private permits currently contains approximately 6,800 names, with about 262 launch positions filled per year. At this rate, private boaters may wait up to 20 years for their trip (Martin of Grand Canyon Private Boaters Association, 2001 personal communication).

Angling

The cool tailwaters of the Colorado River, just below Glen Canyon Dam, have become a world-class rainbow trout fishery. With constant cold water temperatures (released from the bottom of Lake Powell) and a healthy food production cycle, rainbows dominate this part of the river and grow to excessive size. People from all over the world and particularly the Southwest come to try their luck at angling these waters.

There are two main angling concessionaires at Lee's Ferry, with multiple guiding services associated with them. Marble Canyon Guide Services and Fly Shop has been

in business for three years. Its chief competitor, Lee's Ferry Anglers, has been in business since 1989 (Foster of Marble Canyon Guides, 2000 personal communication; Gunn of Lee's Ferry Anglers, 2000 personal communication). Both concessionaires offer guiding services, and also operate small commodities shops that offer tackle, flies, waders, rods, reels, and fishing licenses. There are two types of angling access from Lee's Ferry. The walk/wade-in method, as it states, allows fishermen to hike upstream and downstream from the Lee's Ferry parking sites and work the river banks and gravel bars. Both concessionaires offer guiding services for "walk/wade-in" customers. The going rate is about $150 a person per day. This would usually include a lunch and some of the equipment needed. The more popular method, and more successful (in terms of the number of fish caught), incorporates the use of motor boats. The 20' river boats haul one or two customers and a guide upstream towards Glen Canyon Dam. Within the 15 miles from Lee's Ferry to the dam, there are numerous gravel bars and pools where customers try their luck at landing a trophy rainbow trout. The price of this service starts around $300/day for two people, and about $200/day for one person. The Lee's Ferry angling industry has been estimated at about $3 million a year, when all services are included (Behan, 1999).

Methods

Data Collection

In order to test the two hypotheses, the data were collected through personal interviews and mail surveys. All the boating and angling concessionaires operating in the Grand Canyon and Lee's Ferry received economic impact surveys asking them to detail, in dollar amounts, any costs or benefits associated with the LSSF. For each economic impact reported, an accompanying detailed description was asked for. On completion of data gathering, all impacts were aggregated for each group. Copies of the economic inquiries are located in the appendix. Personal interviews were

conducted with the president and vice-president of the Grand Canyon Private Boaters Association and with the executive director of the Grand Canyon River Outfitters Association. Personal interviews were also conducted with private anglers and angling guides located in Lee's Ferry. Data were also collected from Grand Canyon National Park officials and Grand Canyon River Guides. In expanded regional economic analysis, Coconino County financial data were used to estimate the total effects of the LSSF (IMPLAN data, 1998). IMPLAN data sources include County Business Patterns (CBP), Bureau of Economic Analysis (BEA), and Regional Economic Information Systems (REIS).

Data Analysis

The direct economic impacts of an affected regional industry, in this case recreation, have multiple effects on the local economy. The direct effect is the initial change in the final demand of an industry. In the analysis of the low flows, the direct effect is represented by losses in revenue incurred by angling and rafting concessionaires. Costs of helicopter removals are also included in the direct effect. The initial increase or decrease in final demand results in further effects known as indirect and induced effects. Indirect effects are the changes in the amount of inputs purchased by retailers. With a loss in guided anglers and rafting revenues, the river concessionaires may purchase fewer inputs such as food, lodging, and equipment. The induced effects of river recreation are the changes in overall employment and household income. An influx of recreation revenue would cause local wages to increase and thus "induce" greater regional economic activity. The moderate economic impact of the LSSF created minimal induced effects on local wages and employment. The sum of direct, indirect, and induced effects of a change in final demand are the total economic impacts of river recreation.

Further analysis was needed to assess the total regional economic impacts of the LSSF. The initial data represents the direct effects of the LSSF. These direct

effects, or changes in final demand, were then entered into an input-output model to analyze indirect and induced effects. Only the impacts affecting river concessionaires based in Coconino County were used for the regional analysis; impacts to concessionaires located outside the county region were not included. Harvard economist Wassily Leontief established the modern day framework of input-output models in 1936. Leontief claimed the Nobel Prize in economics for his pioneering effort, which described the structure of the U.S. economy for 1919 (Walsh, 1986). The U.S. Forest Service created the Impact Analysis for Planning (IMPLAN) in the mid-1980s, which utilized input-output methods to estimate the direct, indirect, and induced economic impacts of alternative resource management plans (Isard *et al.*, 1998). IMPLAN has since been used for numerous regional economic impact analyses.

IMPLAN

IMPLAN Professional 2.0 is computer software that uses aggregated databases to construct a picture of the regional economy. This picture of the regional economy is called a social accounting framework (also known as a social accounting matrix), where all output from producers equal all input from purchasers. The social accounting framework is comprised of five main actors: industries, commodities, factors, institutions, and trade (Lindall and Olson, 2000). Industries are composed of businesses that form a particular group (i.e. produce common commodities). IMPLAN has broken state and county data into 528 different industry sectors.

The social accounting framework is the basis for our input/output predictive model. This predictive model will be used to estimate changes in a regional economy due to recreational expenditures (or lack there of in the case of the LSSF). The assessment of changes will be shown in predicted multipliers, which are the total economic impacts generated in the regional economy divided by direct impacts. These multipliers capture the backward linkages associated with final transactions. Backward

linkages are the goods and services purchased by an industry in order to produce a final product. With the Colorado River recreation industry, backward linkages are represented by transactions of visiting boaters and anglers (and river concessionaires) with local suppliers of food, lodging, equipment rentals, and other trip necessities.

Economic impacts of the LSSF accrued to concessionaires based in Coconino County totaled $88,000. Lost angling and rafting expenditures were entered into IMPLAN sector 488 (Amusement and Recreation Services), which is bridged to the Standard Industrial Classification (SIC) codes of 7910, 7991-3, 7996, and 7999. Helicopter rescue expenses were entered into IMPLAN sector 520 (Federal Government – Non-Military). Utilizing the social accounting matrix, IMPLAN derived Coconino County multipliers to show how all other industries are affected by the loss in recreational output. The impact analysis also assessed indirect and induced effects of the LSSF. Employment impacts were included as well.

Results

Rafting concessionaires were affected by the LSSF more than any of the other groups. The aggregated LSSF-related expenses incurred by rafting concessionaires totaled over $70,000. The majority of these expenses were the result of boat and motor damage caused by newly exposed rocks. Some of the cited costs besides boat and motor damages included raft retrieval efforts, increased fuel costs, and personal injuries. It was also noted, that with longer “on-river” times, trip leaders and crews were more stressed. Because of high demand and low availability, the overall volume of trips remained unchanged. Some multiple-day trips did end abruptly, requiring concessionaires to give full refunds for another trip. Commercial day-use rafting (from the Glen Canyon dam to Lee’s Ferry) was not affected by the LSSF. Direct economic impacts to rafting concessionaires (service below Lee’s Ferry) during the LSSF differed

significantly from economic impacts during normal daily operations.

Angling concessionaires held high expectations for the LSSF of 2000, envisioning the lower waters to cause higher concentrations of trout. The fishing was improved by the low flows, but angling concessionaires did not reap tremendous increases in profits. Angling concessionaires saw a slight increase in the number of guided trips and revenue, but the rise in overall trips and revenue was proportional to increased growth for the past five years. During each of the spike flows (one in early May and one in late September), high levels of water and turbidity kept concessionaires from conducting trips. The aggregated loss in guiding services during the spike flows resulted in a loss of $33,000 for angling concessionaires. An unforeseen dilemma of the LSSF may cause future problems for the Lee's Ferry fishing industry. The new beaches that were left exposed by the low water levels are being heavily invaded by tamarisk trees. As river fluctuations resume, many of the prime angling spots may be impenetrable due to the tamarisk. Angling concessionaires have attempted some tamarisk removal efforts and are very concerned. This side effect of the LSSF may have further economic ramifications in the future.

Both private anglers and boaters experienced a few equipment-damaging incidents, but increased interest in lower flows negated any negative economic impacts. Private boaters are better suited for lower flows, because they typically use smaller boats and have a smaller percentage of motor trips than the commercial boaters. Both private boaters and anglers were very excited about the LSSF, but the excitement seemed to be contained locally. Thus, the increase in private anglers was minimal. The overall number of private boating trips remained the same. Economic impacts to private boaters and anglers did not differ significantly during the LSSF.

Additional economic impacts of the LSSF were accrued from three major incidents of commercial boats becoming lodged on exposed rocks. Arizona Rafting Adventures, Tour West, and Western Tour all had trips obstructed or abruptly ended

with passengers stuck in rapids (Crystal, Horn, and Hance respectively). Rescue efforts were costly, relying on helicopters, park rangers, and other boats. Overall, there were three major search and rescue operations, which cost the national park approximately $30,000 (Jalbert of Grand Canyon National Park, 2001 personal communication).

IMPLAN Results

Of all the direct impacts, $88,000 were considered to be costs accrued in the defined region of Coconino County. These direct impacts produce a chain effect of reducing overall output, and thus reducing overall demand. IMPLAN software was used to determine indirect, induced, and total effects of this initial change in final demand. The top five affected industries for indirect, induced, and total effects are presented in Table 1. The most recent available Coconino County data from IMPLAN is for the year 1998. Because these impacts are in 2000 dollars, the initial $88,000 was deflated to $83,526 to match 1998 dollars (by Consumer Price Index for all consumers for all items). Economic impacts were entered into the recreation sector, and the extended effects were found to be: 1) Indirect output resulting from initial impacts = -$15,368; 2) Induced output resulting from initial impacts = -$18,812; and 3) Total output resulting from a loss of $88,000 in the recreation industry = -$117,706. Thus, due to the chain reaction created by a change in final demand, regional economic impacts for the LSSF totaled $124,010 (in 2000 dollars). IMPLAN estimates showed that this loss in recreational revenues correlates to a loss of three jobs in the region.

As seen in Table 1, final demand changes in the recreation sector affect many other local industries as well. The backward linkages associated with the recreation industry (i.e. equipment rentals, food and lodging, electric services, etc.) also endure the economic ramifications caused by direct impacts to the recreation sector. Estimates show that the real estate industry incurred losses of almost $4,000 of output, while the eating and drinking industry suffered a $1,500 output impact. Other affected industries can be seen in Table 1.

Table 1

Output Impact
of $88,000 expenditure loss in recreation sector
(Coconino county)

Indirect Effects	Induced Effects	Total Effects
Top five affected industries (in dollar amounts)	Top five affected industries (in dollar amounts)	Top five affected industries (in dollar amounts)
1.) Real Estate ($2,576)	1.) Owner-occupied dwellings ($2,292)	1.) Recreation Services ($84,170)
2.) Business Services ($1,126)	2.) Doctors and Dentists ($1,520)	2.) Real Estate ($3,844)
3.) Maintenance and Repair ($930)	3.) Hospitals ($1,429)	3.) Owner-occupied Dwellings($2,292)
4.) Electric Services ($838)	4.) Eating and Drinking ($1,277)	4.) Doctors and Dentists ($1,520)
5.) Management and Consulting Services ($769)	5.) Real Estate ($1,269)	5.) Eating and Drinking ($1,503)
Totals: Indirect effects = $15,368	Induced Effects = $18,812	Total Effects = $117,706

* In 1998 dollars

All estimates calculated from IMPLANPro 2001

The cost of the helicopter rescues ($30,000) was included in the $88,000 of direct impact accrued in Coconino County. Because these rescue costs were not charged to concessionaires but rather absorbed by the national park, an alternative IMPLAN estimate was analyzed. This conservative approach focused strictly on the impact of reduced concessionaire output in Coconino County, which totaled $58,000. IMPLAN estimates showed that this loss in recreational output resulted in another $10,129 loss of indirect output and a $12,399 loss from induced output. The total effects of a $58,000 loss in concessionaire expenditure were estimated at $77,579 (in 1998 dollars).

Conclusions

The rafting concessionaires, in particular, were not prepared for such low flows. The relative inflexibility of large, commercial boat trips makes them more susceptible to accidents at such low flows. Many of the river guides had never experienced such low

Figure 1

Figure 1: Commercial Boat Stuck in Crystal Rapid (Courtesy of Arizona Rafting Adventures)

flows, and the problems of navigating exposed rapids were evident. Numerous commercial guides suggested that an LSSF of say, 10,000 cfs, may have prevented many accidents, but its benefit to native fish species may not have been as effective. Angling concessionaires were also somewhat frustrated with the lower flows. While angling was slightly improved by the LSSF, other complications such as spike flows and

tamarisk invasions caused problems for the angling concessionaires.

The LSSF generated high interest among private boaters and anglers, but this did not necessarily translate into positive economic impacts. One of the main issues here, is the restraint on the supply-side of rafting opportunities. With a current waiting list of up to twenty years for the private permit, all slots will be filled---no matter what the flow level is. Thus, a more preferred flow level for the private boater has little effect on economic impacts.

The regional economic analysis shows how other industries can be affected by changes in a particular sector. Economic impacts affecting recreation services were shown to have residual impacts on restaurant, lodging, health care, and business industries. The LSSF of WY 2000 had minimal overall regional economic impacts. While angling and boating concessionaires were significantly affected, the entire Coconino County economy saw minimal repercussions from the LSSF.

Discussion

The use of IMPLAN's input-output model allows us to accurately estimate indirect and induced effects of the LSSF. By entering all direct impacts (for Coconino County) as an overall decrease in final demand in the recreation industry, we are assuming that these impacts also represent decreases in the final demand of other industry sectors (as opposed to benefiting other sectors). Equipment-damaging incidents and search and rescue missions could conceivably be shown to have positive economic effects in other sectors (i.e. equipment rental/production and management training). Moreover, accident rates may have been affected by the amount of experience held by the river guides, as well as different flow levels. Given these assumptions, IMPLAN results are somewhat limited, but are still an accurate description of the extended economic effects of the LSSF.

Another limitation deals with the short-run and long-run effects of industry

operations. Because the LSSF is currently a one-time experiment, economic impacts are dealt with on a short-run basis. This suggests that losses in revenue and expenditure may not be fully expressed in the change in final demand of the entire recreation industry. Summer operations for concessionaires (including payments for equipment, food and lodging, etc.) are planned well in advance; and LSSF-related expenses would typically be absorbed by concessionaires on a per-incident basis. However, if future LSSFs were planned, concessionaires would have to allocate more resources towards preparation of these summers. This long-run approach would have permanent economic ramifications on the Colorado River recreation industry.

The results of this study show some of the same conclusions reached by previous works. Bishop *et al.* (1987) concluded that the benefits of day-use rafting are not sensitive to flow levels. Wilderness River Adventures, the only day-use concessionaire, had minimal economic impacts from the LSSF. Douglas and Harpman (1995) found that employment levels did not vary significantly with flow regime. In this study, IMPLAN estimates show a loss of three jobs in the defined region due to the LSSF. This would not be construed as a significant variation in employment. However, output results indicate that river concessionaires (with the exception of day-use rafting) are sensitive to extreme flow changes. There is a need to explore many more of the socio-economic issues pertaining to recreation on the Colorado River. Economic impact studies diagramming the flow of all services and goods involved in Grand Canyon recreation would show the importance of the recreation industry to Northern Arizona. Future studies should also focus on the sustainability of recreation on public lands, and the opportunity costs of alternative management plans such as mining, timber-harvesting, and hydropower. All of the results of this research are contributing to new understandings of the recreation-based economies dependent upon the existing Grand Canyon ecosystem. The research can be used in the Adaptive Management Program to optimally balance ecosystem function with sustainable development.

Literature Cited

Bishop, R. C., K. J. Boyle, M.P. Welsh, R.M. Baumgartner, and P.C. Rathbun. 1987. Glen Canyon dam releases and downstream recreation: an analysis of user preferences and economic values. (Glen Canyon Environmental Study Report #27/87). Washington, D.C.: U.S. Bureau of Reclamation.

Behan, J. 1999. Technical report to Grand Canyon Monitoring and Research Center.

Bergstrom, J.C., H.K. Cordell, G.A. Ashley, and A.E. Watson, 1990b. Economic impacts of recreational spending on rural areas: a case study. Economic Development Quarterly. 4: 29-39.

Cordell, H.K., J.C. Bergstrom, G.A. Ashley, and J. Karish, 1990. Economic effects of river recreation on local economies. Water Resources Bulletin. 26: 53-60.

Douglas, A.J. and D.A. Harpman. 1995. Estimating recreation employment effects with IMPLAN for the Glen Canyon Dam region. Journal of Environmental Management. 44: 233-247.

English, D.K. and J.M. Bowker. 1996. Economic impacts of guided whitewater rafting: a study of five rivers. Water Resources Bulletin. 32: 1319-1328.

Hall, T. and Bo Shelby. 1998 Grand Canyon Boaters Survey. Technical report to Grand Canyon Monitoring and Research Center.

IMPLAN Professional Analysis Guide. 1999. Technical Report. Minnesota IMPLAN Group, Inc.

Isard, W., I.J. Azis, M.P. Drennan, R.E. Miller, S. Saltzman, and E. Thorbecke. 1998. Methods of interregional and regional analysis. Brookfield, VA: Ashgate Publishing, Inc. 44-54.

Johnson, R. L. and E. Moore. 1993. Tourism impact estimation. Annals of Tourism Research. 20: 279-288.

Lindall, S. and D. Olson. 2000. Introduction to IMPLAN.

Stewart, W., K. Larkin, B. Orland, D. Anderson, R. Manning, D. Cole, J. Taylor, N. Tomar. 2000. Preferences of recreation user groups of the Colorado River in Grand Canyon. Grand Canyon Monitoring and Research Center.

Walsh, R.G. 1986. Recreation economic decisions: comparing benefits and costs. State College, PA: Venture Publishing, Inc.

Appendix A: Economic Inquiry of Angling Concessionaires

Economic Impacts of the Low Summer Steady Flow on Angling Concessionaires

An experimental Low Summer Steady Flow of 8,000cfs, was conducted this past summer in order to facilitate the recovery of the endangered humpback chub and other native fish. Accompanying the LSSF is a research-based "Science Plan," issued by the Grand Canyon Monitoring and Research Center, which assesses impacts and will be the baseline for multi-year studies. The compilation of research will be applied to future decisions of flow management. Included in the overall project is a study on the economic impacts of the LSSF on recreation. The two main groups of recreators on the Colorado River (from Glen Canyon Dam through the Grand Canyon) are whitewater boaters and anglers. As one of the few concessionaires allowed to operate in and about the Grand Canyon, your information on economic impacts incurred is critical to this study.

Following this memo is an economic impact inquiry. Please delineate in monetary terms all economic impacts directly attributable to the LSSF. A brief description, along with the number of incidents would sufficiently enhance the data. All individual information will be kept confidentially, and aggregate totals for the industry will be used in the final product. When finished with the inquiry, please mail it to the address below. The project will finish in August of 2001, and any interested outfitters will certainly get a copy. If you have any questions or concerns, please contact me. Your time and information is greatly appreciated.

Sincerely,

Evan E. Hjerpe
evanhjerpe@msn.com
(520) 214-0903

Please mail to: Evan Hjerpe
College of Ecosystem Science and Management
PO Box 15018
Flagstaff, AZ 86011-5018

Economic Impact Inquiry

I) Please list any major accidents and/or equipment damaging incidents (over $1,000 worth of damage) attributable to the LSSF. Include all related costs (boat or motor repairs, refunds, etc.) and descriptions.

II) Please aggregate the cost of all minor damages incurred because of the LSSF. Include motor, boat, and any other equipment damages.

III) Please list any economic impacts (benefits or costs) related to scheduling, sales, and overall number of trips.

IV) Please assess economic impacts (current and future) of the tamarisk invasion of many angling areas. Include costs of removal efforts and overall impact.

V) Please detail any other economic impacts attributable to the LSSF.

Additional Comments:

Appendix B: Economic Inquiry of Boating Concessionaires

Economic Impacts of the Low Summer Steady Flow on River Concessionaires

An experimental Low Summer Steady Flow of 8,000cfs, was conducted this past summer in order to facilitate the recovery of the endangered humpback chub and other native fish. Accompanying the LSSF is a research-based "Science Plan," issued by the Grand Canyon Monitoring and Research Center, which assesses impacts and will be the baseline for multi-year studies. The compilation of research will be applied to future decisions of flow management. Included in the overall project is a study on the economic impacts of the LSSF on recreation. The two main groups of recreators on the Colorado River (from Glen Canyon Dam through the Grand Canyon) are whitewater boaters and anglers. As one of the few concessionaires allowed to operate in and about the Grand Canyon, your information on economic impacts incurred is critical to this study.

Following this memo is an economic impact inquiry. Please delineate in monetary terms all economic impacts directly attributable to the LSSF. A brief description, along with the number of incidents would sufficiently enhance the data. All individual information will be kept confidentially, and aggregate totals for the industry will be used in the final product. When finished with the inquiry, please mail it to the address below. The project will finish in August of 2001, and any interested outfitters will certainly get a copy. If you have any questions or concerns, please contact me. Your time and information is greatly appreciated.

Sincerely,

Evan E. Hjerpe
ehjerpe@dellnet.com
(520) 214-0903

Please mail to: Evan Hjerpe
College of Ecosystem Science and Management
PO Box 15018
Flagstaff, AZ 86011-5018

Economic Impact Inquiry

I) Please list any major accidents and/or equipment damaging incidents (over $1,000 worth of damage) attributable to the LSSF. Include all related costs (rescues, refunds, hotel charges, etc.) and descriptions.

II) Please aggregate the cost of all minor damages incurred because of the LSSF. Include motor, boat, and any other equipment damages.

III) Please list any economic impacts (benefits or costs) related to scheduling and overall number of trips.

IV) With lower flows, actual time on the river increases. Please discuss economic ramifications of longer “on-river” times.

V) Please detail any other economic impacts attributable to the LSSF.

Additional Comments: