United States
Department of
Agriculture

Forest Service

Southern
Research Station

General Technical
Report SE-91

Estimating the Economic Impacts of Recreation Response to Resource Management Alternatives

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April 1995

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P.O. Box 2680
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Abstract

Managing forest resources involves tradeoffs and making decisions among resource management alternatives. Some alternatives will lead to changes in the level of recreation visitation and the amount of associated visitor spending. Thus, the alternatives can affect local economies. This paper reports a method that can be used to estimate the economic impacts of such alternatives. Methods for deriving representative final demand vectors and for estimating visitation response to management alternatives are presented. These methods are illustrated in two empirical examples that involve delaying water-level drawdown at mountain reservoirs. One example is for four reservoirs in western North Carolina; the other is for two reservoirs in northern California.

Keywords: Economic impact, recreation, reservoir level, resource management.

Introduction

In developing and amending management plans for their forests, planners for the National Forest System (NFS) account for the consequences of proposed management changes on the forests and their users and the surrounding communities. Recently, attention has focused on changes in recreation opportunities and their effects on local economies. This paper describes a general method to estimate the regional economic impacts of resource management alternatives. Two studies on the relationship among reservoir levels, recreation use, and the local economy illustrate method application.

Theoretical Background

Regional economic impacts of a project or policy are the changes in the economic activity within the region that result from that project or policy (Randall 1987). Regional economic impact analysis focuses on exogenous changes in final demand for goods and services produced in that region (Stevens and Rose 1985). Impacts include and are often measured in changes in the real value of industrial output (goods and services), employment, and proprietor and household income within the region (Sassone and Schaffer 1978). Most economic impact is assessed through some form of general equilibrium model. Starting from an initial equilibrium, these models assume an exogenous change caused by the policy or project under study and calculate the resulting hypothetical equilibrium.

The direct, indirect, and induced effects of the exogenous change represent the total economic impact (Richardson 1973). For example, when recreation visitation increases, direct effects are the first-round purchases made by businesses to meet the increased demand for their products by recreation visitors (Bergstrom and others 1990). Indirect effects occur as the first-round input suppliers make additional purchases to meet increased demands of their clients. The direct and indirect effects result in an overall production increase that can lead to more local or regional employment and income. As residents spend their increased income, further rounds of economic activity are generated. These are the induced effects.

Regional economic impacts of recreation are based primarily on visitor expenditures associated with the production of recreation trips. The money that visitors spend for items such as food, lodging, and transportation becomes fuel for the local economy. Management alternatives that affect the amount or type of money spent will then affect the local economy. When assessing economic impacts, recreation is considered a basic exporting industry; therefore, only nonresident expenditures are included. Resident spending for recreation trips within the region represents a transfer of money within the region and does not contribute to economic growth (Alward and Lofting 1985; Bergstrom and others 1990; Bockstael and McConnell 1981; Cordell and others 1992; Lieber and others 1989).

However, a management alternative can cause residents to switch trip destinations from a site outside the region to one inside the region. When this occurs, the regional economy experiences a reduction in its importing of recreation service (less local money 'leaks' out of the economy). The overall result is a net increase in money spent on recreation in the local economy. These switches in destination produce a positive economic impact; however, most studies do not include them.

Method

To estimate the regional economic impacts of a resource management alternative, a planner must have three sets of information: (1) an indication of the magnitude of the changes, based on the expected size of the visitation change, positive or negative, for each alternative; (2) an indication of the nature of the changes for each alternative, measured by some summarization of the profile of expenditures made by the various types of recreation users; and (3) an economic model of the target economy.

Visitation Changes

Accurate estimates of visitation response to resource management alternatives is often the most difficult information to obtain or estimate. Most public agencies do not collect visitation data at their sites. The dispersed nature of many activities and the variety of access types and locations usually make collecting this data prohibitively expensive. Thus, baseline estimates of current recreation use and how use varies over the year frequently rely on general observations by managers and field personnel.

Estimating visitation changes resulting from resource management changes is even more difficult. Such estimates can be developed through user surveys, expert panels, or behavioral models. Unfortunately, the nonmodeling methods rely on individuals' opinions about contingent future states and are often considered far less reliable than behavioral models.

Ex post verification of the predictions developed from these methods is seldom done, often for the same reasons that initial baseline visitation data are not collected.

Current users can be surveyed for their expected-use levels in different management scenarios. Somewhat expensive, this method is subject to strategic responses by users and does not include potential response from nonusers. This method could provide a lower bound to visitation increases, since visitation increases from current nonusers would not be included.

Expert panels are groups of individuals knowledgeable about the site, its resource attractiveness, and its use patterns. These panels can be assembled and asked to estimate aggregate visitation response to selected management or resource changes. This method may also be susceptible to strategic behavior, and its results are not always considered reliable by managers, policy makers, or researchers.

Modeling entails predicting aggregate changes in trip behavior of recreating households within the market area of the site in response to changes in management action. Acquiring sufficient data for these models can be expensive. In addition, determining accurate visitation-response measures can be quite complex, because site demand in most models depends simultaneously on the availability, quality, and proximity of both target and substitute sites (Fesenmaier and Leiber 1985; McCollum and others 1990). Without good baseline visitation data, models of site demand (see, for example, Kim and Fesenmaier 1990; Peterson and others 1983; Peterson and others 1985) that include resource amounts or quality levels as site-demand predictors cannot be developed.

However, general models of recreation demand can be used to develop estimates of possible changes in recreation use or visitation on national forests in response to proposed management changes. National and regional models of recreation demand have been developed for use in the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) (Cordell and others 1990; English and others 1993). These models estimate the total number of trips emanating from an origin without regard to the destination.

By using reported coefficients for the explanatory variables for recreation consumption (English and others 1993) and values for those variables appropriate to the market area of the forest, an estimate of total trips generated from that market area can be obtained. Changes in the number of generated trips per unit change in resources can also be calculated by resource variable. Multiplying the change in trips per unit change in resources by the size of each resource change proposed in the management alternative yields the change in total number of trips generated in the market area caused by the proposed alternative.

The two approaches that determine how many of these total trips occur on the forest are based on different assumptions. First, because the only resource change is on the forest, one could assume that all increases or decreases in trips will occur on the forest. This approach also assumes that no location or activity substitution occurs. For example, if a forest increases the amount or quality of a resource, additional trips to the forest are assumed to come only from new trips generated in the area. No increases will come from people switching destinations from another site in the area, such as a state park, or from people switching trip activities to take advantage of the improved resource base.

A second, more conservative approach is possible if estimates of current forest use are available. With this information, the forest's market share of trips can be calculated. Assuming this market share remains constant, the total-trip increase on the forest is equal to the product of the total-trip increase in the market area and the market share fraction. This approach leads to less volatile changes in recreation use when compared with the first approach.

Total final demand changes for a resource management alternative are determined by multiplying the change in the number of trips for a user type by the per trip vector of sectorial final demand changes. The result is the set of final demand event changes used as input for the IMPLAN model of the target economy.

Visitor Expenditure

Expenditure data for visitors to a site or area are not always readily available. From 1985 to 1989, the Public Area Recreation Visitor Study (PARVS) collected expenditure data for a variety of Federal locations in the Southeastern United States. Since then, a similar survey method, entitled CUSTOMER, has been used to collect expenditure data for particular types of users at USDA Forest Service and USDI Bureau of Land Management sites. The data from these surveys may be reasonably representative of the entire set of users of national forests and other public lands in the Southeast. However, the same is not generally true for the remainder of the country, primarily because the amount of data collected is inadequate and CUSTOMER sites are self-selected.

For site-level analysis, the best data is collected by interviewing a random sample of users at the targeted site. If site-specific data are unavailable, expenditure data from similar, nearby sites could serve as proxies as long as planners use their knowledge of the resource area to determine if applying proxy-site data is appropriate. Because expenditures for different commodities can have different types and levels of impacts on local economies, obtaining expenditure data for major expenditure categories is recommended. Examples of these categories include public and private lodging, food and beverages bought at stores, food and drinks bought at restaurants and bars, gasoline and oil, recreation services (such as guides or equipment rentals), sporting goods, souvenirs, and clothing.

Regardless of the source of the expenditure data, the profiles of expenditures made by different user types must be summarized. The most common summary is the average amount spent per person per trip. Including a confidence interval is also recommended, so the range of expected impacts can be estimated. If the distribution of expenditures is highly skewed, the median may be a more appropriate summary statistic and a nonparametric confidence interval may be estimated (Bowker and MacDonald 1993).

If the sampling plan involves a random survey of visitors on site, visitors who stay longer may be sampled more than those who stay for a shorter time. When this is the case, an appropriate weight must be assigned to each observation. A weight suggested in the past for similar research applications is normalization by the multiplicative inverse of stay length (Schreuder and others 1975).

Items bought by visitors are usually compatible with the commodity sectors in the IMPLAN model. Sometimes, margining of reported expenditures by category is necessary, especially if expenditure data is aggregated into major categories. The allocation algorithm reported here is used by the Southern Research Station and is based on national annual personal consumption expenditure data and input-output tables prepared by the Bureau of Economic Analysis from 1987 (table 1). Applying the sectorial allocation algorithm to the expenditure profile for a visitor type yields final-demand changes by IMPLAN commodity sector for that visitor type, measured in dollars per visit.

Table 1 has two commodity allocations for food and beverages bought at stores, one for visitors engaging in developed activities and one for visitors engaging in dispersed activities. This represents the authors' views that the market basket of food goods is different for these two groups. For example, those engaging in developed site activities, especially campers and picnickers, often use perishable, high-weight goods, such as ice, fruit, fresh meat, and milk, that visitors participating in dispersed activities are less likely to consume.

Economic Model

Many studies of the economic impacts of recreation visitation have used input-output models to simulate the regional economy. The USDA Forest Service IO model, IMPLAN, has been modified to better estimate the effects of recreation visitation. The advantages and disadvantages of IMPLAN have been widely discussed (Alward and Lofting 1985; Alward and others 1985; Bergstrom and others 1989, 1990; Cordell and others 1989, 1990, 1992; Hotvedt and others 1988; Propst 1985).

In previous studies of the economic impacts of recreation visitation, the size of the regional economy has ranged from single communities to entire States. Planners often delineate the target economy as the area that includes all counties that physically include part of the management unit undergoing plan development or amendment. For example, when examining alternatives for a Forest Plan, the target economy would include all counties that contain a portion of that national forest.

Empirical Examples

The two empirical studies described in this section illustrate method application. Both are about recreation-visitation response to proposed changes in managing water levels in reservoirs during the recreation season. Both studies used similar data collection methods. During the recreation season, exit interviews were conducted on a stratified random sample of reservoir users. Strata were selected to represent major user types according to expected differences in expenditure patterns and visitation response to management alternatives.

Data collected at the site included visitation and travel patterns. Respondents were asked to give their address for a follow-up mail survey, which would include trip-related expenditures, recreation equipment purchases in the past 12 months, and equipment-use patterns. To collect expenditure data, one study used the PARVS instrument; the other used the CUSTOMER instrument. Survey procedures followed Dillman's (1978) method.

Trip-related expenditures within the general categories of food, lodging, transportation, activities, and other were divided into three groups: those made at or near home, those made en route to and from the site, and those made at or near the site. For equipment purchases, such as recreational vehicles (RV), boats, and related accessories, respondents reported total expenditures and the portion of expenditures occurring in their home county. Only expenditures made in the local area by nonresidents were relevant for determining economic impacts. Methods for allocating both trip-related and annual equipment expenditures to the local area have been developed through the cooperation of government and academic researchers (Propst 1985; Watson and Brachter 1987).

All trip-related expenses made at or near the recreation site were assumed to occur within the impact region. Trip-related expenditures made at or near home were assumed to be made outside the local impact region. En route expenses were assumed to be equally likely in each mile traveled. Further, it was assumed that visitors would take the most direct route possible to the visited site. A straight line from home to site was calculated for each visitor, and the point where this line entered the local impact region was noted. The proportion of the straight line lying within the impact region equaled the expected percentage of all en route expenses occurring in the local region.

Equipment purchases not made in the respondent's home county were spatially allocated based on equipment-use patterns. It was assumed that the purchases not made near home were made during a recreation trip.[1] Annual spending for each equipment type was divided by the number of trips on which the equipment was used in the last 12 months. This number was multiplied by the ratio of equipment use at the visited site to total equipment use. The result was the expected annual equipment purchases in the region attributable to recreation trips to the specified site.

Western North Carolina

Pressures from many sources, including recreation users and recreation-related businesses, have caused the Tennessee Valley Authority (TVA) to examine the effects of alternative water level-management policies at selected reservoirs. Interest has centered on the regional economic impacts of expected increases in recreation in response to higher summer water levels at four reservoirs in the mountains of North Carolina—Lakes Chatuge, Fontana, Hiwassee, and Santeetlah.[2]

The TVA has managed the water levels in these reservoirs for flood control and hydropower. Water levels peak in late spring as the reservoirs capture runoff from December through April. Water levels are drawn down from early summer until late fall to generate power and to establish excess reservoir capacity to capture runoff. This policy involves tradeoffs with recreational use because drawdown results in exposed banks, reduced aesthetic appeal, and reduced access for boating, fishing, and swimming.

Both reservoir managers and local business people agree that recreation visitation decreases as water levels drop (*Atlanta Journal-Constitution* 1991). The primary reasons for decreases in visitation are reduced surface acreage and access. Normal reservoir operation patterns reduce surface acreage by over 20 percent at three of the four reservoirs. By August, many boat ramps are unusable, many houseboats are stranded, and many coves with submerged rocks are hazardous. Exposed steep slopes (up to 35 degrees at Fontana) and large mud flats surrounding the water, especially at Chatuge, hamper foot access. The alternatives being considered involve holding water levels near full for 1, 2, or 3 more months of the year. These alternatives will be referred to as Alternatives 1, 2, and 3, respectively.

Visitation Changes. The impact region included six counties in western North Carolina: Cherokee, Clay, Graham, Macon, Jackson, and Swain. In 1988 and 1989, data were collected from May to September. Strata were defined by four user types: day, overnight, boating, and nonboating. Overnight users spend more time on site than day users per trip, and they purchase meals and lodging that day users do not. Boaters' expenditures were expected to be higher than nonboaters, reflecting the additional costs of boat use. Because boaters' activities are more directly affected by water levels, their visitation increase in response to management alternatives was expected to be greater than for nonboaters.

To estimate the economic impacts of policy changes, estimates were needed of visitation changes resulting from alternative reservoir management policies. First, total change in visitation was estimated at each lake under each management alternative. Two sources provided data: current users and an expert panel. Current users were asked in a mail survey questionnaire how often they visit the lake and how often they anticipate visiting under each management alternative. This represented the lower bound for visitation change because it assumed no visitation increase from new visitors to the reservoirs.

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[1] In future studies, considerations and modeling of durable equipment expenditures made away from home on nonrecreational trips would be desirable.

[2] A detailed description of the study background, management options, and data collection can be found in Cordell and Bergstrom (1993).

Second, an expert panel assigned to each lake was asked to estimate the anticipated percent change in visitation for each user type when comparing current management policy to each management alternative. The panel considered two sources of increased visits: (1) new visitors to the reservoirs, and (2) increased numbers of visits by current users. "Expert panel" estimates represented the upper bound.

A middle visitation-change scenario was calculated as the mean of the upper and lower bounds. This middle scenario was used for the impact example. Total expected changes in visits were developed by multiplying the percent change by the baseline visitation for each user type at each lake. Because this study was only concerned with increases in nonresident visitation, expected total visitation increases at each lake were multiplied by the proportion of nonlocal visitation in the current sample by lake and user type. The proportions ranged from 22 percent for day nonboaters at Santeetlah to 93 percent for overnight nonboaters at Fontana.

In terms of percent, visitation at Fontana and Hiwassee was expected to be the most responsive to water level changes. Interestingly, current management practices have the greatest impact at these two reservoirs (table 2). Current management at Fontana draws water down 45 feet below the full level. Hiwassee undergoes the greatest loss in surface area from the full level (33 percent). Santeetlah has limited access facilities, which may explain why its visitation was least responsive. Estimated increases in visitation were as expected across user types. For all lakes and management alternatives, estimated percentage increases for boaters were greater than for nonboaters, and estimated percentage increases for overnight users were greater than for day users.

The absolute magnitude of the estimated increases in nonresident visits for each lake and user type is presented by management alternatives in table 3. Holding all four reservoir water levels near the full level 1 month longer could result in an additional 320,000 visits, of which about 130,000 could be overnight visits. Keeping water levels near full for 2 additional months could yield 640,000 more nonresident visits, of which about 255,000 could be overnight visits. Maintaining near full water levels for 3 extra months could result in 1.08 million more nonresident visits, of which over 455,000 could be overnight use.

Expenditures. The average expenditures in 1988 dollars per person per trip in the six-county area ranged from slightly more than $21 for day users at Hiwassee to just under $130 for overnight nonboaters at Fontana (table 4). Overall, between one-half and two-thirds of trip purchases made in the local area were for food and lodging. Generally, boaters spent more per trip in the local area than nonboaters, notably for transportation and activities. Overnight users spent more than day users, primarily for lodging and food.

Economic Impacts. Economic changes were measured in 1990 dollars. Table 5 presents the changes in the total industrial output, income, and number of jobs in the regional economy resulting from 1,000 trips by nonresidents of each type of user at each lake. Impacts vary by lake and user type: the smallest impacts from day users of Lake Santeetlah and the largest impacts from overnight nonboaters at Lake Fontana. For each user type, visitors to Lake Fontana generated higher levels of regional economic impacts than visitors to the other three lakes.

Multiplying the visitation increase by the response coefficients for each lake and user type and then summing user types yields the total impact to the local area from recreation increase associated with each management alternative at each lake (table 6). The differences in impact response across the four North Carolina reservoirs suggest that the method presented in this paper can be useful in developing policy to facilitate multiple-objective operation of resources, such as reservoirs operated by TVA in western North Carolina. Lakes Chatuge and Fontana have a relatively high degree of recreation infrastructure development and current visitation. Lakes Hiwassee and Santeetlah are essentially undeveloped areas. Economic responses to visitation increases were generally greatest at the more developed reservoirs. This suggests that an efficient way to affect local economic development through recreation may be to focus agency efforts on higher summer water levels at Lakes Chatuge and Fontana.

Northern California

The local impact region for this study included Shasta and Trinity Counties. The effect of changes in water-level management on several key indicators was estimated for Shasta Lake and Trinity Lake using a model that integrated a visitation prediction model, the IMPLAN model, and supplementary projections from an expert panel.[3] In addition to the three primary economic indicators of total industrial output (TIO), total income (TI), and employment in full-time equivalents (FTE), two other indicators, final demand (FD) and value added (VA) were also included.

Data were collected from May to September of 1992 using the CUSTOMER instrument. Strata were defined by five primary user types at each lake. For Shasta Lake the categories included houseboating, other boating, developed camping, dispersed camping, and fishing. For Trinity Lake the categories were houseboating, other boating, developed camping, fishing, and scenic driving.

Visitation Changes. For this study, detailed Bureau of Reclamation water-level data for both lakes and USDA Forest Service visitation data were used to develop linear regression visitation models for each lake. Annual visitation in thousand recreation visitor days (RVD) was specified as a function of water level at the beginning of the recreation season (May for Shasta Lake and June for Trinity Lake), the amount of drawdown between the water level at the beginning of the season and September, and a time trend to reflect a trend in recreation tastes and preferences. The Shasta Lake visitation equation is specified as

$$\text{LnVisits} = b_o + b_1 \ln(\text{May}) + b_2 \ln(\text{Drop}) + b_3 \ln(\text{Year}) + u_i \quad (1)$$

where

$b_o, b_1 \ldots$ = regression coefficients,
ln = the natural logarithm,
May = mean May water level at Shasta Lake for a given year in feet above sea level,
Drop = that year's drop in feet of the average monthly water level from May to September,
Year = the year of observation, and
u_i = the random disturbance term.

[3] A detailed description of the background, management alternatives, and data collection for this study can be found in Bowker and others (1994).

Table 7 reports the regression model estimates, based on 20 years of data, for Shasta Lake. As indicated by the R^2 statistic, the estimated model explains more than 90 percent of the variation in observed visitation. All of the explanatory variables are highly significant with intuitively plausible signs. Annual visitation is positively affected by higher water levels in May. The Year coefficient is positive, indicating that when other factors are held constant, recreation visitation has been increasing over the past 20 years. Visitation is negatively influenced by drawdown in the water level during the recreation season. Elasticities, representing the percent change in visitation resulting from a 1 percent change in explanatory variables, are also reported.

For Shasta Lake, predicted visitation ranges from roughly 1.7 million RVD under the drought baseline to about 3.9 million RVD under nondrought alternative 2 (table 8). In a drought season, management changes can effect a 10-percent increase in visitation by restricting seasonal water drawdown to a minimum as represented by alternative 2. In nondrought conditions, the number of annual RVD increases dramatically primarily because of the increased water levels in May. In this case, restricting drawdown to a minimum (alternative 2) would lead to an increase in visitation of about 25 percent.

The Trinity Lake visitation model was similar to the Shasta Lake model except a binary variable was included in the Trinity Lake model to account for a number of years in the mid-seventies when the data are suspect. The Trinity Lake visitation equation is

$$\text{LnVisits} = a_o + a_1 \ln(\text{June}) + a_2 \ln(\text{Drop}) + a_3 \ln(\text{Year}) + a_4 \text{Dumdat} + v_i \quad (2)$$

where

$a_o, a_1 \ldots$ = regression coefficients,
ln = the natural logarithm,
June = the June average monthly water level at Trinity Lake in feet above sea level,
Drop = the drop in feet of the average monthly water level from June to September,
Year = the year of observation,
Dumdat = a binary variable indicating certain data suspect years, and
v_i = the random disturbance.

Table 9 reports the regression model estimates for Trinity Lake based on 24 years of data. The R^2 statistic indicates that the estimated model accounts for more than 86 percent of the variation in observed visitation. As with the Shasta Lake model, the parameter estimates have intuitively plausible signs, i.e., higher water levels in June mean more annual visits, while lower water levels from increased drawdown during the recreation season mean fewer visitors. Again, there is a positive time trend in visitation.

Table 10 shows predicted visitation for Trinity Lake in 1993 under baseline and alternative management schemes during drought and nondrought conditions. The predicted mean annual visitation ranges from approximately 350,000 RVD under baseline drought conditions to 507,000 RVD under nondrought alternative 2. This difference represents a potential visitation fluctuation under managed and natural conditions of about 45 percent, considerably less than Shasta Lake's 130 percent.

In a drought year, the model predicts a 4 to 5 percent increase in visitation when drought alternative 2 is compared with the historical baseline. In a nondrought year the influence of alternative management is even less pronounced, exhibiting about a 3 percent increase over the 492,000 baseline for alternative 2. In general, the results show that drawdown at Trinity Lake has a smaller impact on visitation than at Shasta Lake both in percentage and absolute terms.

Expenditures. Table 11 presents the mean nonresident-expenditure profiles for different user types to Shasta and Trinity Lakes. In spite of substantial average equipment expenditures for some user types, the majority of the money spent by nonresident visitors is on food, lodging, and transportation.

Economic Impacts. IMPLAN results per 1,000 visits of each activity type are reported for Shasta Lake in table 12 and for Trinity Lake in table 13. At Shasta Lake, houseboating and other boating have the most impact in terms of economic output, producing $212,000 and $272,000 TIO per 1,000 visits and 4.9 and 6.1 FTE, respectively. At Trinity Lake, houseboating and fishing appear to have the most economic impact, supporting $329,000 and $411,000 TIO per 1,000 visits and 7.7 and 9.5 FTE, respectively.

To assess total impacts for each water-level management alternative, IMPLAN results were multiplied by predicted annual visitation at each lake for the various management alternatives, as provided by the visitation models. Available data were not sufficiently disaggregated to allow prediction of visitation by user type. To solve this problem, an expert panel was used to estimate the percentage of each user type for the respective management alternatives at each lake. Each of the eight panel participants estimated the visitation composition for each alternative. Group high and low estimates were discarded, and means were calculated. Table 14 reports the means for drought and nondrought years at each lake. The panel members agreed that visitation depended more on natural conditions (drought or nondrought) than on management alternatives.

Weighted economic impacts for each management alternative and lake were derived by combining expert panel estimates of visitation percentages with IMPLAN output. These weighted impacts were then combined with predicted visitation for each lake and alternative to obtain estimates of the relevant economic indicators. Predicted visitation in each case was scaled by the estimated proportion of nonresidents (67.3 percent at Shasta, 83.3 percent at Trinity) and by the average time on site (5.43 days at Shasta, 5.49 days at Trinity). These numbers were obtained from a separate on-site random sample because the CUSTOMER method is based on a given number of observations for each category, making it inappropriate for deriving population parameters. In addition, sampling took place only under one management alternative at each lake. It was assumed that the percentage of nonresidents and the average time on site per trip would not vary under different, natural conditions and management alternatives. Both estimates are probably conservative because surveying occurred during a relatively extreme drought (drought baseline alternative).

Table 15 shows the total economic impacts of alternative water-level management and natural conditions at Shasta Lake. Depending on natural conditions and management, total output supported by nonresident recreation spending ranges from $24.09 to $56.21 million per year, while employment ranges from 553.1 to 1289.4 FTE per year. Under drought conditions, management alternatives lead to potential differences of 54 jobs and approximately $2.39 million in regional economic output (TIO) when comparing drought baseline conditions to drought alternative 2 conditions. Under nondrought conditions, the management alternatives lead to potential differences of $11.44 million TO and 262.5 FTE.

Based on the economic impact analysis, it appears that under drought conditions, management alternatives on Shasta Lake have relatively small impacts on the two-county economy. Under nondrought conditions, TIO and FTE increase significantly, and the effects of alternative management have a potentially great impact on the economy.

Drought and nondrought conditions are based on past drawdown schemes. If nondrought water levels are attainable in drought years, the impacts of management are more profound. Comparing nondrought alternative 2 with the drought baseline indicates a difference of 736 FTE and $32.12 million regional TIO. Even under the nondrought baseline, output and employment nearly double when compared with the drought baseline. These results appear to suggest that starting recreation seasons at near full water levels is important. This could mean that managing a drawdown may have minimal effects during a drought year. However, economic impacts are likely to be greater in the following year.

The economic impacts of alternative management and natural conditions at Trinity Lake are reported in table 16. It is apparent that Trinity Lake recreation has a smaller effect on the two-county economy, which is attributed to the large disparity in visitation between the two lakes. Regional TIO supported across the management alternatives in drought conditions ranges from $7.08 to $7.18 million, while employment ranges from 168.3 to 170.7 FTE.

Under nondrought conditions, output and employment exhibit some increase with TIO ranging from $9.71 to $10.01 million and employment ranging from 231.3 to 238.4 FTE. However, when compared with Shasta Lake, the differences in employment and output from baseline drought conditions to the best recreation conditions (nondrought alternative 2) are relatively minor, with $2.93 million TIO and 70.1 FTE. The absolute difference in visitation and the relative insensitivity of visitation at Trinity Lake to natural conditions and management alternatives explain this difference.

The combined economic impacts, based on a weighted average for both lakes are reported in table 17. Shasta Lake impacts dominate the overall impacts accounting for 77 to 84 percent of the employment supported and for 77 to 85 percent of stimulated regional total output.

Table 18 reports percentage changes in indexed economic impacts for the individual lakes and for a weighted aggregate of both lakes. These results demonstrate that Trinity Lake impacts are small relative to those generated by recreation spending at Shasta Lake. Management alternatives at Trinity Lake, in either drought or nondrought conditions, do not result in much variation in economic impacts within a given year.

Under drought and nondrought conditions, the greatest impacts for the two-county economy would result if water levels at the start of the season were maintained at Shasta Lake. While all impacts appear to be dominated by actions at Shasta Lake, Trinity Lake management alternatives appear to differ very little in generated economic impacts.

The small impacts associated with Trinity Lake recreation must be interpreted carefully. The economic impact model is based on both Shasta and Trinity Counties. The City of Redding is responsible for the economic disparity between these counties—the Shasta county economy accounts for more than 75 percent of the two-county model. In this context, the economic impacts of recreation at Trinity Lake are relatively minor. However, in the context of Trinity County alone, the impacts of recreation at Trinity Lake are much more important. Therefore, a management strategy that focuses on maintaining higher water levels in Shasta Lake at the expense of Trinity Lake may seem efficient from a regional perspective but may result in inequitable economic hardships for Trinity County.

Future Research Needs

Increases in nonresident visits can come from either an increase in the total number of recreational trips in response to a shift in recreational supply or from a shift in trip destination with no increase in overall number of trips. For example, keeping water levels high for a longer period of time may prompt some households to take more recreation trips, including some trips to the study reservoirs. Alternatively, total trips may remain unchanged, but the proportion of trips to one of the study reservoirs may rise, or the proportion of trips across activities may change. If increased visitation to the study reservoirs comes from a shift in destinations, local gains in economic activity may come at the expense of activity elsewhere. Indeed, if the shift is from one site in the region to another, no regional economic gains are realized, as long as the composition of trip types and spending are stable. Future studies should attempt to determine how resource management alternatives affect the number of trips nonresidents take to all sites in the targeted economic region. A more accurate picture of the net change in trips to the targeted region can then be obtained.

In addition, residents of the local area are expected to increase their use of the reservoirs under any of the management alternatives. To the extent that local residents shift their trip destinations from reservoirs or other substitute activities outside the local area to ones inside the region, leakage of money for the "import" of recreation purchased in other areas will cease. The increased "domestic" purchases of recreation will result in economic growth. Therefore, changes in recreation behavior of local residents, as well as nonlocal residents, should be included when estimating the regional economic impacts of resource management alternatives. This, too, will require data on the effect of resource changes on individuals' choices of recreation destinations.

The two empirical studies cited here took different approaches to estimate the level of visitation change that would occur for each management alternative. The modeling approach, using historical resource and visitation data to predict future visitation, is preferred if reasonably accurate visitation figures exist for a number of years. Unfortunately, visitation levels for most public recreation areas and sites are notoriously unreliable. Improving these visitation estimates is a critical research need. Without accurate visitation data or even some idea of the reliability of current estimates, analysts can neither assess whether predicted economic impacts of resource management changes are realistic nor verify whether previous studies are accurate.

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Table 1—IMPLAN commodity sector allocation algorithm for major expenditure items

Purchase Item	Implan commodity	Item to commodity	Commodity description
		pct	
Food brought at stores (developed activities)	16	2.74	Fruits
	17	0.12	Tree nuts
	18	4.61	Vegetables
	58	11.02	Meat packing plants
	59	9.26	Sausages
	60	4.59	Poultry
	61	0.46	Butter
	62	2.65	Cheese
	64	1.04	Ice cream
	66	2.21	Canned specialties
	67	5.03	Canned fruits and vegs
	68	0.85	Dehydrated food
	69	1.60	Pickles, sauces, salad
	70	2.41	Frozen fruits, juices
	71	2.92	Frozen specialties
	73	2.04	Cereal preparation
	75	1.17	Blended flour
	79	7.25	Breads, cakes
	80	2.49	Cookies, crackers
	81	0.88	Sugar
	82	4.13	Confections
	83	0.54	Chocolate, cocoa
	84	0.56	Chewing gum
	90	1.11	Shortening, oils
	97	1.13	Canned seafood
	98	0.27	Packaged fish
	99	2.07	Coffee
	100	5.03	Potato chips and snacks
	101	1.03	Manufactured ice
	102	1.40	Macaroni and spaghetti
	103	2.75	Other food preparations
	104	8.95	Cigarettes
	105	0.32	Cigars
	106	0.65	Chewing tobacco
	199	6.79	Toilet articles
Foods bought at stores (dispersed activities)	16	3.53	Fruits
	17	0.16	Tree nuts
	18	5.87	Vegetables
	58	13.79	Meat packing plants
	59	11.59	Sausages
	62	3.32	Cheese
	66	2.77	Canned specialties
	67	6.29	Canned fruits and vegetables

Table 1—IMPLAN commodity sector allocation algorithm for major expenditure items (continued)

Purchase item	Implan commodity	Item to commodity	Commodity description
		pct	
	68	2.06	Dehydrated food
	69	2.01	Pickles, sauces, salad
	73	2.55	Cereal preparation
	75	1.46	Blended flour
	79	9.07	Breads, cakes
	80	3.11	Cookies, crackers
	81	1.10	Sugar
	83	0.68	Chocolate, cocoa
	84	0.70	Chewing gum
	97	1.41	Canned seafood
	99	2.59	Coffee
	100	3.63	Potato chips and snacks
	102	2.89	Macaroni and spaghetti
	104	10.44	Cigarettes
	105	0.41	Cigars
	106	0.82	Chewing tobacco
	199	7.44	Toilet articles
Beverages bought at stores (developed activities)	65	17.84	Fluid milk
	70	7.42	Frozen fruits, juices
	91	29.22	Malt liquors
	93	8.80	Wine, brandy, etc.
	94	9.53	Distilled liquors
	95	27.19	Soft drinks
Beverages bought at stores (dispersed activities)	91	39.10	Malt liquors
	93	11.77	Wine, brandy, etc.
	94	12.75	Distilled liquors
	95	36.38	Soft drinks
Food bought at restaurants/bars	454	100.00	Eating/drinking places
Gasoline and oil	210	97.93	Refined petroleum
	213	2.07	Lubricating oils
Airfares	437	100.00	Air transportation
Car rentals	477	100.00	Auto rental/leasing
Other transport.	434	79.81	Interurban passenger

Table 1—IMPLAN commodity sector allocation algorithm for major expenditure items (continued)

Purchase item	Implan commodity	Item to commodity	Commodity description
		pct	
Transportation	439	20.19	Travel agents
Lodging, private sector	463	100.00	Hotels/lodging places
Lodging, public sector	--		Do not include
Clothing	111	2.27	Hosiery
	124	96.47	Apparel from cloth
	225	0.45	Leather gloves
	228	0.82	Personal leather goods
Footwear	216	21.54	Rubber/plastic footwear
	224	78.46	Shoes, except rubber
Recreation equip. rental	473	2.81	Equipment leasing
	488	97.19	Amusement/rec. services
Live bait services	26	100.00	Agriculture/forestry/fish
Prepared bait	98	100.00	Packaged fish
Fishing tackle	421	100.00	Sporting and athletic goods
Hunting/fishing permits	24	0.52	Forestry/fishery products
	489	67.19	Membership sports/rec clubs
	512	32.29	State/local government
Ammunition	297	100.00	Small arms ammunition
Film	413	100.00	Photographic supplies
Film developing	471	100.00	Commercial photofinishing
Outfitter and guide services	488	100.00	Amusement/recreation services

Table 2—Anticipated increases in recreation visitation by lake, for each water-level management alternative, low (L), middle (M), and high (H)

Lake	Management alternative 1			2			3		
	L	M	H	L	M	H	L	M	H
	Percent								
Chatuge	13.8	23.2	32.5	21.8	56.2	90.6	25.6	76.9	128.1
Fontana	22.5	37.8	53.1	52.5	69.8	87.1	82.5	150.7	218.8
Hiwassee	8.4	47.4	86.3	24.1	68.6	113.1	52.4	102.5	152.5
Santeetlah	10.6	19.1	27.5	43.6	46.8	50.0	60.6	64.7	68.8

Table 3—Anticipated increases in nonresident visitation by lake and water level management alternative, middle estimate (1,000 visits)

Lake/user type	Current (baseline)	Management alternatives 1	2	3
Chatuge:				
Day boater	92.1	22.1	52.6	68.8
Overnight boater	150.5	40.6	99.1	158.0
Day nonboater	164.9	33.7	85.6	105.4
Overnight nonboater	73.2	20.2	41.5	66.1
Fontana:				
Day boater	93.9	42.0	84.0	166.3
Overnight boater	74.4	30.8	43.6	111.2
Day nonboater	97.5	28.7	55.7	124.3
Overnight nonboater	19.1	5.1	8.9	20.3
Hiwassee:				
Day boater	51.4	31.3	39.1	64.1
Overnight boater	26.0	16.4	20.6	29.9
Day nonboater	60.9	20.0	39.1	51.1
Overnight nonboater	25.2	9.0	11.7	19.0
Santeetlah:				
Day boater	34.4	8.6	18.6	25.0
Overnight boater	58.5	7.2	22.9	34.5
Day nonboater	18.7	3.8	10.0	12.9
Overnight nonboater	44.4	4.5	11.7	19.5

Table 4—Direct spending by nonresidents within the six-county impact region, mean per person per trip

Lake/user type	(N)	Lodging	Food	Trans-portation	Activity	Other	Equip-ment	Total
		Expenditure category						
		1988 dollars						
Chatuge:								
Day nonboater	10	6.60	5.20	1.60	2.70	5.95	0.00	22.05
Day boater	28	0.57	3.96	10.87	3.11	5.64	0.91	25.06
Overnight nonboater	28	35.61	22.80	4.72	14.97	3.89	0.00	81.99
Overnight boater	50	21.76	26.23	16.33	9.23	7.34	2.28	83.17
Fontana:								
Day nonboater	19	19.81	34.00	10.48	2.77	0.31	0.00	67.37
Day boater	32	3.26	8.43	30.76	6.03	0.27	0.00	48.75
Overnight nonboater	27	62.23	31.71	13.52	12.99	9.16	0.00	129.61
Overnight boater	64	36.01	18.87	11.54	17.22	4.08	4.61	92.33
Hiwassee:								
Day users[1]	25	8.37	5.95	2.26	3.41	1.22	0.00	21.21
Overnight nonboater	11	20.45	25.21	5.83	3.23	1.36	0.00	22.09
Overnight boater	33	25.66	35.98	41.05	12.80	10.68	0.61	126.78
Santeetlah:								
Day users[1]	12	4.33	4.64	11.36	1.79	0.00	0.00	22.12
Overnight nonboater	40	1.78	14.02	5.72	1.12	3.94	2.13	28.71
Overnight boater	32	8.03	18.41	10.97	9.05	8.17	1.10	55.73

[1] Boaters and nonboaters at these lakes could not be separated because of a limited number of observations.

Table 5—Annual changes in economic indicators of total gross output, total income, and employment due to increases of 1,000 nonlocal recreational visits to western North Carolina reservoirs, six-county local impact area

Reservoir/ user type	Total industrial output	Total income	Employment
	Thousands of 1990 dollars		*Number*
Chatuge:			
Day nonboater	2.9	1.4	0.1
Day boater	3.1	1.6	0.6
Overnight nonboater	58.5	35.1	2.2
Overnight boater	40.4	23.5	1.4
Fontana:			
Day nonboater	29.2	18.0	1.0
Day boater	11.7	7.0	0.5
Overnight nonboater	96.5	59.2	3.5
Overnight boater	60.9	37.6	2.3
Hiwassee:			
Day user	8.0	4.6	0.3
Overnight nonboater	24.3	14.3	0.9
Overnight boater	45.4	26.9	1.5
Santeetlah:			
Day user	0.1	0.0	0.0
Overnight nonboater	0.1	0.1	0.0
Overnight boater	0.1	0.1	0.0

Table 6—Total economic changes for six-county area by reservoir and management alternative

Reservoir/ management alternative	Total industrial output	Total income	Employment
	Thousands	*of dollars*	*Number*
Chatuge:			
Alternative 1	2,988	1,746	118
Alternative 2	6,843	3,990	270
Alternative 3	10,769	6,291	418
Fontana:			
Alternative 1	3,697	2,271	138
Alternative 2	5,969	3,662	222
Alternative 3	14,306	8,784	534
Hiwassee:			
Alternative 1	1,373	806	48
Alternative 2	1,845	1,081	65
Alternative 3	2,741	1,606	97
Santeetlah:			
Alternative 1	2	1	0.4
Alternative 2	6	4	1
Alternative 3	9	6	2

Table 7—Annual visitation regression model parameter estimates for Shasta Lake

Variable[1]	Coefficient	t-stat	Prob >t	Elasticity
Constant	-458.3800	-5.4240	0.000	--
Ln (year)	55.9490	5.0911	0.000	55.9470
Ln (May level)	6.0427	9.7098	0.000	6.0427
Ln (recdrop)	-0.1684	-2.4756	0.022	-0.1684
rho	0.3044	1.4293	0.168	--

[1] Ln (annual recreation visitor days/1,000)—n = 20, R^2 = .9055, Adj R^2 = .8877, S^2 = 0.010895—corrected for first-order auto correlation with Cochran-Orcutt iterative least squares procedure (Greene 1990, p. 443).

Table 8—Estimated mean annual visitation at Shasta Lake under drought and nondrought conditions and alternative management scenarios

Condition	Recreation visitor days[1]
Drought baseline	1,699,373
Drought alternative 1	1,769,990
Drought alternative 2	1,867,838
Nondrought baseline	3,095,257
Nondrought alternative 1	3,458,226
Nondrought alternative 2	3,886,394

[1] Corrected for log bias using the "naive factor," $\exp(s^2/2)$ (Flewelling and Pienaar 1981, p. 285).

Table 9—Annual visitation regression model parameter estimates for Trinity Lake

Variable[1]	Coefficient	t-stat	Prob >t	Elasticity
Constant	-437.86000	-5.3927	0.000	--
Ln (year)	49.58800	5.1520	0.000	49.58800
Ln (June level)	8.67780	3.3100	0.001	8.67780
Ln (Recdrop)	-0.02185	-0.5588	0.582	-0.02185
Dumdat	0.58508	7.4367	0.000	--
rho1	0.40172	2.1056	0.048	--
rho2	-0.35555	-1.8636	0.076	--

[1] Ln (Annual recreation visitor days/1,000)—n = 24, R^2 = .8661, Adj R^2 = .8380, S^2 = 0.018823—Corrected for second-order auto correlation with Cochran-Orcutt iterative least squares procedure (Greene 1990, p. 447).

Table 10—Estimated mean annual visitation at Trinity Lake under drought and nondrought conditions and alternative management scenarios

Condition	Recreation visitor days[1]
Drought baseline	349,128
Drought alternative 1	351,681
Drought alternative 2	354,128
Nondrought baseline	491,858
Nondrought alternative 1	499,354
Nondrought alternative 2	506,982

[1] Corrected for log bias using the "naive factor," $\exp(s^2/2)$ (Flewelling and Pienaar 1981, p. 285).

Table 11—Average nonresident per trip expenditures in Shasta and Trinity Counties, by lake and user type

Lake/user type	Lodging	Food	Transportation	Activities	Other	Equipment
	Dollars					
Shasta Lake:						
Developed camping	16.40	29.58	78.79	4.30	9.01	30.14
Dispersed camping	6.12	21.27	17.86	6.06	3.45	22.78
Fishing	9.48	16.61	31.17	3.77	1.28	15.37
Houseboating	17.28	14.81	19.94	4.62	2.72	61.76
Other boating	10.23	12.35	19.59	4.47	2.83	245.25
Trinity Lake:						
Developed camping	42.29	40.82	8.02	1.94	5.52	10.74
Dispersed camping	45.47	27.32	12.32	7.63	8.81	8.52
Houseboating	27.82	31.50	68.67	7.41	2.82	40.89
Other boating	10.54	26.47	13.99	5.23	3.59	22.37
Scenic driving	16.38	8.89	2.53	0.54	1.51	84.88

Table 12—IMPLAN total economic impacts per 1,000 visits to Shasta Lake by user type

Activity	Final demand	Total output	Personal income	Value added	Employment[1]
	Millions of 1990 dollars				*Number*
Houseboating	0.1736	0.2118	0.1222	0.1448	4.9
Other boating	0.2261	0.2723	0.1586	0.1911	6.1
Developed camping	0.1182	0.1455	0.0810	0.0952	3.4
Dispersed camping	0.0931	0.1134	0.0657	0.0775	2.8
Fishing	0.0693	0.0847	0.0479	0.0569	2.1

[1] Reported in full-time job equivalents per 1,000 visits.

Table 13—IMPLAN total economic impacts per 1,000 visits to Shasta Lake by user type

Activity	Economic impact: Final demand	Total output	Personal income	Value added	Employment[1]
	Millions of 1990 dollars				*Number*
Houseboating	0.2677	0.3291	0.1825	0.2144	7.7
Other boating	0.0893	0.1093	0.0618	0.0723	2.9
Developed camping	0.1366	0.1709	0.0961	0.1119	4.1
Scenic driving	0.0795	0.0978	0.0558	0.0662	2.4
Fishing	0.3375	0.4108	0.2370	0.2836	9.5

[1] Reported in full-time job equivalents per 1,000 visits.

Table 14—Expert panel predicted activity percentages for Shasta Lake and Trinity Lake

Condition	Activity: Houseboat	Other boat	Developed camping	Dispersed camping	Scenic driving	Fishing
	Percent					
Shasta drought	33	27	10	10	--	20
Shasta nondrought	35	27	12	10	--	16
Trinity drought	21	25	18	--	10	27
Trinity nondrought	20	26	31	--	5	18

Table 15—Total economic impacts of recreation spending at Shasta Lake under alternative water-level management and natural conditions

Condition	Economic impact				
	Final demand	Total output	Personal income	Value added	Employment[1]
	Millions of 1990 dollars				*Number*
Drought baseline	19.84	24.09	13.89	16.56	553.1
Drought alternative 1	20.65	25.10	14.47	17.25	576.1
Drought alternative 2	21.80	26.48	15.27	18.20	607.9
Nondrought baseline	36.85	44.77	25.81	30.76	1026.9
Nondrought alternative 1	41.17	50.02	28.84	34.37	1147.3
Nondrought alternative 2	46.27	56.21	32.41	38.63	1289.4

[1] Reported in full-time job equivalents.

Table 16—Total economic impacts of recreation spending at Trinity Lake under alternative water-level management and natural conditions

Condition	Economic impact				
	Final demand	Total output	Personal income	Value added	Employment[1]
	Millions of 1990 dollars				*Number*
Drought baseline	5.77	7.08	4.00	4.72	168.3
Drought alternative 1	5.81	7.13	4.02	4.75	169.5
Drought alternative 2	5.86	7.18	4.05	4.79	170.7
Nondrought baseline	7.91	9.71	5.47	6.45	231.3
Nondrought alternative 1	8.03	9.86	5.55	6.55	234.8
Nondrought alternative 2	8.16	10.01	5.64	6.65	238.4

[1] Reported in full-time job equivalents.

Table 17—Combined total economic impacts of recreation spending at Shasta Lake and Trinity Lake under alternative water-level management and natural conditions

Condition	Economic impact				
	Final demand	Total output	Personal income	Value added	Employment[1]
	Millions of 1990 dollars				*Number*
Drought baseline	25.61	31.17	17.89	21.28	721.4
Drought alternatives 1	26.47	32.22	18.49	22.00	745.6
Drought alternatives 2	27.66	33.66	19.32	22.99	778.6
Nondrought baseline	44.73	54.48	31.28	37.22	1258.2
Nondrought alternatives 1	49.21	59.88	34.39	40.92	1382.1
Nondrought alternatives 2	54.43	66.22	38.05	45.29	1527.7

[1] Reported in full-time job equivalents.

Table 18—Changes in total economic output (percentage deviation from baseline) for Shasta Lake and Trinity Lake under alternative water-level management and natural conditions

Condition	Indexed economic impact		
	Shasta Lake	Trinity Lake	Weighted aggregate
	Percent		
Drought baseline	0.0	0.0	0.0
Drought alternative 1	4.2	0.7	3.4
Drought alternative 2	9.9	1.4	8.1
Nondrought baseline	0.0	0.0	0.0
Nondrought alternative 1	11.7	1.5	10.1
Nondrought alternative 2	25.6	3.1	22.0

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Managing forest resources involves tradeoffs and making decisions among resource management alternatives. Some alternatives will lead to changes in the level of recreation visitation and the amount of associated visitor spending. Thus, the alternatives can affect local economies. This paper reports a method that can be used to estimate the economic impacts of such alternatives. Methods for deriving representative final demand vectors and for estimating visitation response to management alternatives are presented. These methods are illustrated in two empirical examples that involve delaying water-level drawdown at mountain reservoirs. One example is for four reservoirs in western North Carolina; the other is for two reservoirs in northern California.

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