Environmental Determinants of Demand for River Recreation

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Received: 1992 Feb 24; Revised: 1992 May 13

Although several methods have been developed for measuring factors affecting long-term recreation trends, few have examined what accounts for short-term changes in recreation demand. This study examines weather and stream discharge as transient environmental characteristics influencing recreation participation. A simple method for measuring how these factors affect the environmental suitability of a river area is developed utilizing data corresponding to the Illinois River, a heavily used recreational stream in northeastern Oklahoma. Stream discharge, daily low temperature, and cloud cover are useful predictors of river recreation demand when coupled with a variable corresponding to weekend versus weekday. The information presented may be useful in expanding our understanding of behavioral responses to short-term changes in recreational environments and may assist planners and commercial operators in estimating markets.

INTRODUCTION

The increasing popularity of rivers and the associated impacts on physical resources have prompted investigation of methods for mitigating environmental damage and forecasting long and short-term trends in river use. Although a number of methods for projecting long-term recreation trends have been developed (*1-4*), few adequately addressed techniques for short-term forecasts, specifically those that consider ephemeral yet influential changes affecting the recreational suitability of environments.

This study examines short-term environmental factors that influence participation in river recreation. Short-term factors are here defined as environmental characteristics that change on an hourly or daily basis. The specific objective is to develop a simple method for measuring the effects of weather and stream discharge on recreation participation by using data collected for the Illinois River in northeastern Oklahoma. The information presented may be useful in explaining human responses to changes in recreational environments and may aid planners, commercial operators, and others in estimating markets.

Forecasting

Forecasting performs an important role in most government agencies since virtually all decision-making and planning is based upon an understanding of, or assumptions about, the future. Forecasting recreational participation involves an understanding of the behavior of the participants. Stynes (*5*) suggests that the reason for a lack of forecasting in recreation organizations is the relatively recent development of the science of recreation management. The study of outdoor recreation management has a relatively limited collection of theory, methods, and data from which to draw. As Stynes suggested, the lack of time series data and a dependence upon cross-sectional research techniques has limited our knowledge of the dynamics of recreation systems. Furthermore, as Oliveira and Rausser (*6*) have noted, most recreation studies that have examined use over time have focused on the prediction of annual participation rates or levels rather than on explaining short-term fluctuations in use. While long-term forecasts are tied to general trends in recreation over time, short-term decisions to visit a recreation area may be based on ephemeral conditions.

Recreational Choices

Decision-making theory assumes that behaviors are the outcome of decisions between different courses of action, and that choices are guided by the expected benefits accruing from the alternatives (*7*). A major theme of recreation research is the identification of motives behind these choices in terms of environmental variables. Yapp and McDonald (*8*) suggest that

because recreation is voluntary, choice behavior will depend on an individual's perception of the environment as suitable.

Several environmental attributes can affect an individual's decision on whether to participate in a river recreation activity. These can include site characteristics, distance to the recreation area, and the availability of nearby other such areas offering similar facilities. However, two ubiquitous and often overlooked factors affecting river recreation are the short-term influences of weather and stream discharge.

Weather

Increasing demand for weather information is partly the result of growth in the leisure time available to an affluent society. Unlike activities that can be conducted indoors, outdoor recreation is dependent on weather conditions. Oliveira and Rausser (*6*) suggest that, when treated as time-varying characteristics, weather conditions affect the overall attractiveness of a recreational area. In their study of campground use, Oliveira and Rausser forecasted daily use levels over a season using econometric analysis and noted that the availability of campsites is strongly related to weather. Other studies, such as Wagner's (*9*), compared recreational attendance rates by calculating recreational adjustment factors to meteorological conditions.

Yapp and McDonald (*8*) note that participation is conditioned by a range of social, economic, and other environmental factors, with weather serving as a major determinant of recreation behavior. They suggest that models relating potential participation to commonly recorded weather data would be valuable for recreation planning and management.

Paul (*10*) has pointed out that the potential recreationist will consider the following four weather circumstances before embarking on an outing: 1) on-site weather, 2) conditions at the trip origin, 3) the forecast, and 4) conditions as anticipated by the recreationist. Duffell (*11*) investigated relationships between the use of urban parks and measurable weather parameters including temperature, sunshine, and rainfall. Although the study was directed at participation rates for urban recreation facilities, Duffell noted that studies involving weather data could be used for assessing the demand on recreational areas in rural areas.

Stream Discharge

Jahn (*12*) has noted that in the last three decades (1960-90) the importance of streamflow has become recognized as essential to maintaining conditions necessary for wildlife, ecological processes, and recreation. A number of researchers have examined the relationship between stream discharge and recreational activities on rivers. Hecock (*13*) notes that on-stream recreational opportunities have been shown to vary abruptly with changes in flow conditions. A study by Narayanan (*14*) measured visitor reactions to hypothetical changes in streamflows to determine marginal benefits of stream discharge.

Moore, Wilkosz, and Brickler (*15*) used logistic regression to determine whether visitors' perceptions of streamflow were related to actual stream discharge. Their study demonstrated that the perceptions of river users concerning streamflow may be closely related to actual stream discharge. As streamflow decreased, people became more likely to indicate that flows were less than desired. Even small reductions in the normal stream discharge were noticeable to some visitors. Their conclusions suggest that improved information is essential in planning proposed water developments, licensing hydroelectric plants, and other activities that may affect stream discharge.

Study Area

Located in northeastern Oklahoma, the Illinois Scenic River provides opportunities to recreationists from throughout Oklahoma and surrounding states; however, a significant percentage of visitors to the river come from the Tulsa Metropolitan area. The recreational section of the river extends approximately seventy miles from the Arkansas-Oklahoma border to Tenkiller Reservoir in east-central Oklahoma (Figure 1). Numerous sites along the river provide access to individuals and canoe rental concessionaires. Streamflow varies seasonally, with discharge highest in the spring and lowest in the late summer.

In the 1970s, the increased popularity

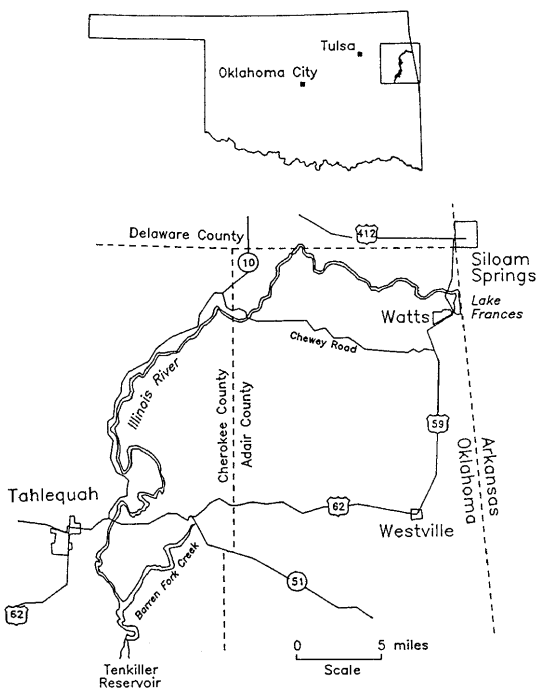

Figure 1. Location of the Illinois River

of river-based activities led to an abrupt increase in recreational usage, from three hundred canoes rented in the 1970 season to approximately 36,000 in 1975. Around 1990 the average number of floaters using the river yearly was just over 60,000 (*16*). Principal river activities include canoeing, swimming, tubing, and fishing. Of these, canoeing has shown the most dramatic increase in popularity over the last 20 years.

Recreationists using the Illinois River include residents of urban (especially Tulsa and Oklahoma City) as well as local areas, and they are individuals, families, and members of large groups such as churches, schools, corporations, clubs, and civic organizations. As Hecock and Tweedie (Hecock, R.D. and Tweedie, S.W., Summary of Illinois River Use Estimates. unpublished report, Oklahoma State University Department of Geography, 1980) note, about 92% of recreationists on the river rented their canoes and over 98% of those people were day users. The peak time of the day for floaters is generally around 2:00 pm; use falls dramatically after 4:00 pm. According to Hecock and Tweedie (unpublished), the most popular float trip length was twelve to fifteen miles (48% of floaters), followed by seven to eleven miles (28% of floaters) and sixteen to twenty miles (10% of floaters).

Since the 1970s, the river has been managed by the Oklahoma Scenic Rivers Commission, established by the Oklahoma Scenic Rivers Act of 1970 to protect and administer 70 miles of the upper portion of the river. Although policy decisions concerning the river are the responsibility of the commission, day-to-day operations are handled by a staff supervised by a full-time executive administrator.

DATA COLLECTION

Participation rates on the Illinois River are generally much higher on weekends and holidays than on weekdays (Hecock and Tweedie, unpublished). For this reason the study focuses on identifying changing environmental rather than social characteristics of recreation activities. Participation in river recreation is assumed to be affected by the perceived suitability of transient resource characteristics. To test this hypothesis, daily weather data were collected for high and low temperature, precipitation, relative humidity, cloud cover, and wind speed. These parameters were chosen to follow Yapp and McDonald's (*8*) findings concerning the effects of weather conditions on outdoor recreation. The data were collected for 1984-89 and covered the river use season from May 1st to September 30th.

As noted by Green (*17*) temperature can affect recreational comfort. Daily high and low temperatures were compiled from records collected by the National Oceanic and Atmospheric Administration (1984-89) for the meteorological station located in Tahlequah, Oklahoma (*18,19*). Since high and low daily temperatures were highly correlated (r=0.74), both variables could not be used in the model. Low temperature was selected over high temperature because of its higher correlation with the dependent variable, daily participation rate. Low temperatures for the study period ranged from 39 to 75 °F with a mean of 62.7 ºF.

Daily precipitation, collected at the Tahlequah station, was also used to test whether river participation may be influenced by even trace amounts of rainfall. A low correlation between precipitation and participation would be consistent with the results of Duffell (*11*), who found little

association between precipitation and campground use. Precipitation during the study period ranged from zero to two inches per day with about 70 percent of the study-period days having no measurable rainfall.

Because insufficient information is collected at the Tahlequah meteorological station, data for cloud cover, wind speed, and relative humidity were taken from daily information collected at the Tulsa International Airport. This reporting station, located about 50 miles from Tahlequah, is the closest first-order station to the study area and has conditions like (although not identical to) those at the station in Tahlequah. The data for cloud cover, measured in tenths, ranged from zero-tenths (sunny) to ten-tenths (totally overcast). Wind speed ranged from zero (calm) to 40 miles per hour. Finally, relative humidity ranged from 100% to 45%.

TABLE 1. Canoes rented by weekday versus weeken and factors affecting recreation participation.

	Days in Study Period		Daily Average Canoes Rented	
Weekdays	616		182	
Weekends & Holidays	302		1172	
Variable[a]	Parameter Estimate	Partial R^2	F	Prob>F
WK	869.480	0.3940	233.43	0.0001[b]
RD	-0.064	0.1076	30.52	0.0001[b]
LT	19.673	0.0389	35.95	0.0001[b]
CC	-303.806	0.0366	25.03	0.0001[b]
RH	-4.428	0.0066	4.89	0.0275[c]
WS	-13.892	0.0064	4.81	0.0288[c]

[a] *WK* = weekday/weekend, *RD* = river discharge, *LT* = daily low temperature, *CC* = cloud cover, *RH* = relative humidity, *WS* = wind speed.
[b] significant at the .05 level
[c] significant at the .01 level

Stream discharge data were provided by the Tulsa office of the U.S. Geological Survey. These data, collected as cubic feet per second (cfs), were selected to be consistent with information provided to visitors who contact the Scenic River Commission office for river information prior to a float trip. River discharge measured at the Tahlequah gauging station varied from 16,900 to 71 cfs, with a mean of 696 cfs. The extreme variability in river discharge represents conditions ranging from flood stage to drought.

Although not an environmental factor, the day of the week was also expected to have a positive influence on use and was therefore included as an independent variable. As Oliveira and Rausser (*6*) have suggested, the influence of this variable may be negative if people expect crowded conditions on weekends or holidays and stay at home. The study period included 616 weekdays and 302 weekend days (recognized holidays were grouped with weekend days for this variable). A bivariate coding system was used for this variable to identify weekdays (0) as opposed to weekends/holidays (*1*).

Participation data, represented by the number of floaters renting canoes each day, were compiled from records provided by the Oklahoma Scenic Rivers Commission. This variable was taken to represent the total number of persons who floated the river on each day during the study period. Daily canoe rentals ranged from a high of 2936 to zero (representing days in which the river was closed because of hazardous flooding). As Table 1 shows, the average number of canoes rented on weekdays was 182 while on weekends and holidays the average was considerably higher at 1172 canoes.

ANALYSIS OF DATA

The purposes for performing regression analysis were: 1) to identify independent variables associated with variation in the rate of river use, 2) to measure the relative importance of each variable in explaining participation, 3) to determine the total proportion of variance *(R^2)* in the participation rate accounted for by all transient environmental factors, and 4) to develop a model for projecting rates of participation.

The regression model developed in this study uses the daily participation rate as the dependent variable and low temperature, relative humidity, cloud cover, wind speed, stream discharge, and a variable representing weekday versus weekends/holidays as independent variables. The premise examined is that a decision to participate in river recreation is a function of a recreationist's perception of the suitability of a combination of changeable environmental conditions.

Table 1 displays statistically significant variables found to be related to participation. The model yields an R^2 of 0.59 and an overall F of 66.56 with 6 degrees of freedom, which is significant at the .0001 level.

Parameter estimates shown in Table 1 indicate the expected change in participation associated with the independent variable under consideration. Each independent variable in the final model was significant at the .05 level. The following regression model was then created for projecting recreation demand:

P = -458.259 + 869.48 WK - 0.064 RD - 303.806 CC + 19.673 LT- 4.428 RH - 13.892 WS;

P = participation, WK = weekday/weekend, RD = river discharge, LT = daily low temperature, CC = cloud cover, RH = relative humidity, WS = wind speed.

DISCUSSION

Since separate scales of measurement (i.e. degrees Fahrenheit for temperature, tenths for cloud cover, and cfs for stream discharge) were used for some independent variables, comparisons of the relative importance of parameter estimates were not made. Pedhazur (*20*) notes that comparisons of parameter estimates based on data with dissimilar scales can be misleading. A negative correlation between the dependent variable and river discharge, cloud cover, relative humidity, and wind speed suggests that recreationists generally do not favor high river flow or cloudy, humid, or especially windy days for floating, as might be expected. The model also suggests that participation rates will be higher on weekends and holidays and that floaters prefer higher minimum daily temperatures. The parameter estimate for river discharge suggests that participation rates are higher when river discharge is lower.

The incremental proportions of variance accounted for by each independent variable are shown as partial R-squares in Table 1. The variable corresponding to weekday versus weekend use accounted for about 39% of the variance in participation, while stream discharge accounted for an additional 11%. Low temperature and cloud cover each explained just over 3% of additional variation. Although relative humidity and wind speed each accounted for less than 1% of the variation, these two variables were significant at the .05 level.

Since weekend versus weekday variation was known to be an important factor to river participation rates (Hecock and Tweedie, unpublished), the important implications of the study concern the transient environmental variables identified as significant in explaining recreational use of the river. Stream discharge, daily low temperature, and cloud cover, together account for about 18% of variation in the dependent variable. Findings related to rainfall were consistent with those of Duffell (*11*), who discovered no relationship between precipitation and recreational participation.

CONCLUSION

This study provides some clues concerning the influence of transient environmental conditions on rates of recreation participation. The results provided here should be examined carefully with attention to limitations in the data used. Pedhazur (*20*) notes that variance in the dependent variable used in regression is affected by: 1) the variables being studied, 2) the variables not included in the study, and 3) the errors of measurement of the dependent variable. One possible shortcoming of the analysis was that no provision was made to include behavior associated with human impacts on river environments such as the anticipation of crowding. In addition to this, the study is based on the premise that participation is tied to spur-of-the-moment decisions to participate in a recreation activity. The effects of large groups who made reservations with concessionaires well in advance of their trip were not taken into account. With these limitations in mind, the study is useful in helping to expand our understanding of transient environmental factors that influence river recreation and may also have an effect on other types of outdoor activities. Future research concerning nonlinear relationships between stream discharge and participation rates may help to explain the effects of low flow conditions on river participation rates.

ACKNOWLEDGMENTS

The author thanks Edward H. Fite III of the Oklahoma Scenic Rivers Commission and Professor M. Richard Hackett of Oklahoma State University for their

generous support and assistance with this research.

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