COMPARISON OF DISTANCE DECAY PATTERNS AMONG RECREATIONAL USERS FOR SIX CENTRAL U.S. RIVERS

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1978

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
July, 1979

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PREFACE

This thesis is dedicated to my parents who made countless sacrifices for my benefit.

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INTRODUCTION

Recreation has been a part of man's life for almost as long as he has existed. Everyone needs some type of recreation, whether it is leisurely basking in the sun or vigorous mountain climbing. It is widely believed that recreation is essential to a long and healthy life. The amount and type of recreation participation varies with the individual and his or her own personal goals and wants.

As seen in Figure 1, participation in recreation is expected to increase at a substantial rate. The increase is related partly to population growth, but more importantly to other factors such as increased affluence and change in social values. As participation increases at a more rapid rate, pressures on the recreational resources also increase. The use of rivers for recreational purposes is part of this pattern of growth (see Table I), and increasing pressure on resources.

River recreation has changed greatly. A few years ago it played a very small role in recreation. However, today rivers are a major recreational resource. Indeed, signs of misuse and overuse of rivers are beginning to appear. This is also true of the mental impressions of the

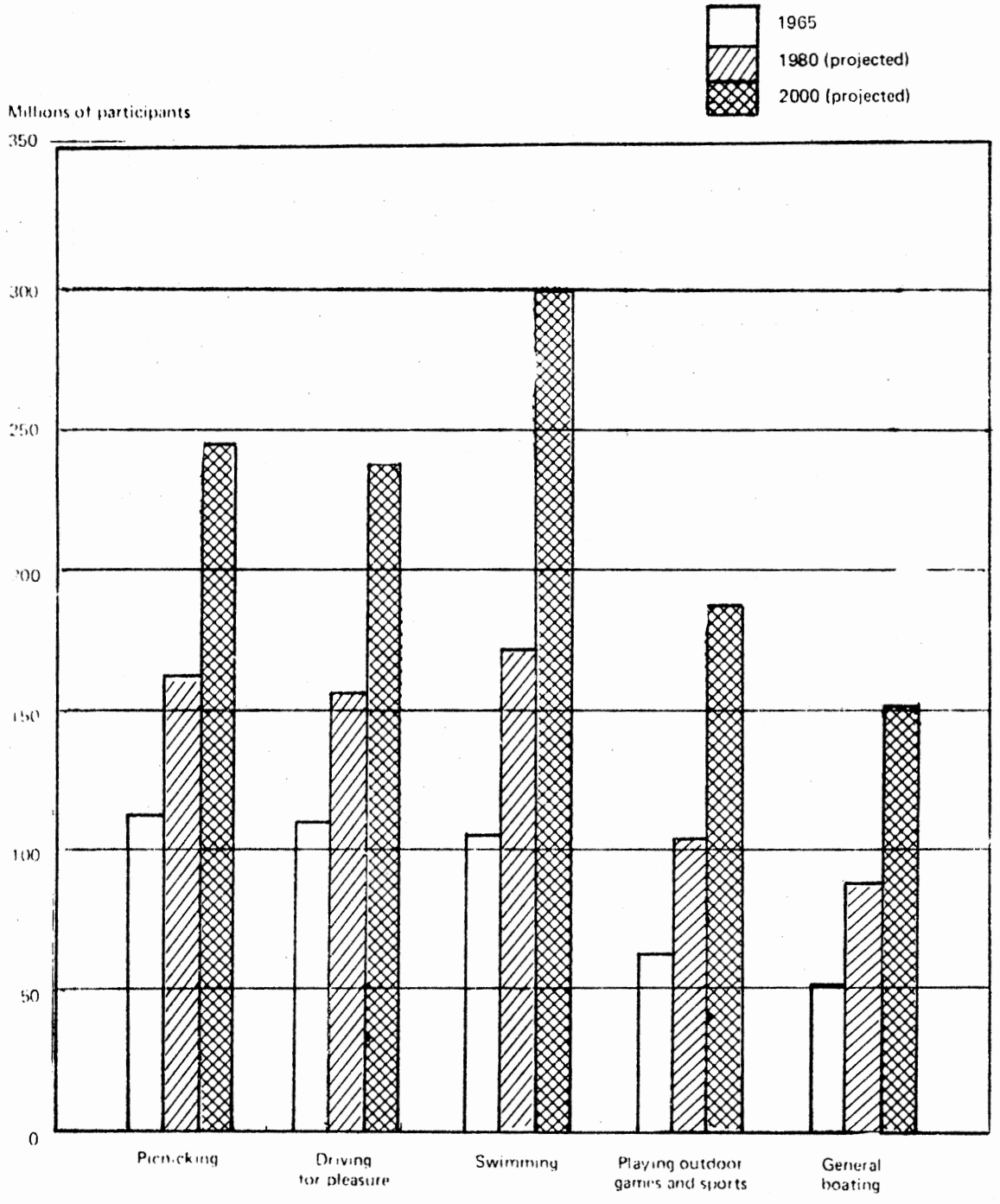

Figure 1. Participants in Outdoor Recreation, by Selected Activity: 1965, 1980 and 2000

TABLE I

RECREATIONAL VISITS FOR SELECTED U.S. RIVERS BY REGION (1965-1978)

River by Region	Visits for years data have been collected[1]										
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
East											
Allagash River (Maine)		4,141	4,539	3,786	4,820	5,460	6,345	7,814	8,337	7,128	9,447
New River (W. Va.)											6,000
Youghiogheny River (Pa.)						17,000				80,000	
Midwest											
Apple River (Misc.)											
Buffalo River (Ark.)										15,505	18,748
Crow Wing River (Minn.)		9,700									
Current River, Ozark National Scenic Riverway (Mo-Ark)										150,000	
Eleven Point River (Mo.)											
Little Miami River (Ohio)						14,000					
Pine River (Mich.)		13,000					50,000		64,000		
Upper Iowa River (Iowa)								3,416	4,386		
West											
Colorado River, Cataract Canyon (Utah)					585	889	1,670[2]	2,439	4,422	4,096	
Colorado River, Desolation Canyon (Utah)						1,600		5,000			
Colorado River, Grand Canyon National Park (Ariz.)	547	1,067	2,099	3,609	6,019	9,935	10,885	16,432[2]	15,219	14,253	
Colorado River, Westwater Canyon, (Colo.-Utah)						318		500			
Green and Yampa Rivers Dinosaur National Monuments (Colo.-Utah)			2,493	3,755	5,740	9,762	14,145	17,159[2]	16,739	12,874	
Rio Grande River, Big Bend National Park (Texas-Mex.)	926	1,540	2,741	2,389	3,996	4,006	4,478	4,421	4,856	6,013	
Rogue River (Oregon)							2,800	4,800	5,885	7,210	
Salmon River, Middle Fork (Idaho)	1,260	1,260	1,299	1,396	1,624	3,028	3,250	3,972	4,372	4,036	
Salmon River, Lower Main (Idaho)									4,003[2]	2,200	
Salmon River, Upper Main (Idaho)									2,593		
Selway River (Idaho)						46	194	406	419	439	
Snake River, Grand Teton National Park (Wyoming)		18,000						71,256	73,885[2]	51,906	
Snake River, Hell's Canyon (Ore.-Idaho)									1,184	1,788	
Stanislaus River (Calif.)										35,000	
South											
Chattooga River (S.C.)						300	700	4,000	10,500	14,500	
Everglades Canoe Trails (Fla.)									4,000	5,000	
Nantahala River (N.C.)								1,000	3,000	4,000	
Okefenokee Canoe Trails (Georgia)							300	500	800	2,000	
Hiawassee						800	1,200		2,000	3,000	

[1]Data from various published and unpublished sources.
[2]Year in which restrictions of some type were instituted.

Source: Richard Hecock, "Recreational Usage and Users of Rivers," Oklahoma State University, 1976.

recreationalists. Rivers have changed from a tool serving transportation needs to a major recreational resource.

Attitudes toward rivers have changed in the mind of the public. Once thought of as primarily corridors for, or barriers to, man's movement, today rivers have multipurpose roles for transportation, hydroelectric sources, recreation, irrigation as well as other activities. In the early 1900's white water was considered a menace to man so rivers were channelized and dammed (Nash, 1977). Today, certain groups of people are involved in the preservation of our free flowing rivers and acts of Congress have been passed to protect them.

It is important to understand the nature and use of recreation resources in order to plan for their future. Such questions as: "Where do users come from?" and "Why do they select certain recreation resources?" must be answered in order to obtain maximum benefits from the resources in the future.

This study addresses one aspect of our lack of knowledge regarding rivers and their use. The purpose is to describe and analyze use of six central United States rivers by determining their user hinterland and travel characteristics.

The remainder of the chapter is devoted to a review of the existing literature on recreation travel in general and travel to river recreation resources in particular. The chapter also outlines in greater detail the specific problem addressed in this thesis.

Review of Literature

Recreational Travel

There is a considerable amount of research done in the area of recreation travel. Different researchers have found that different factors affect travel in different ways.

In 1963, Clawson pointed out that the recreational experience consists of five components: 1) "Planning or anticipation" consists of all pre-trip arrangements and activities. 2) "Travel to recreation site" includes the type of trip and whether it is a short or long trip. 3) "On site experiences" are activities and time actually spent at the recreation area. 4) "Travel from the recreation site" can be over a different route or over the same route as travel to the site. Often more time is spent traveling to and from the recreation site than time spent at the site itself. 5) "Recollection" consists of thoughts, ideas, and conversation after the trip is over.

Recreational travel can be viewed from two general perspectives in so far as its relationship to the overall recreational experience is concerned. First, recreational travel can be considered as lost time or an unpleasant interlude to be endured in reaching the recreation area (Foss, 1965), in short, travel is a cost. On the other hand, it can be viewed as an enjoyable portion of the entire recreational experience. Keough (1969) provided evidence that 86 percent of the drivers to recreation facilities enjoyed

spending time traveling, but the majority of them chose a particular route because it was the fastest. Keogh (1969, p. 115) concluded that from the responses of drivers who did consider time and cost of travel: "Time was the most significant element in determining the distance a driver would travel on a day trip." Clawson (1963) determined that the longer the travel required the fewer the visits that are made to the area. Wolfe (1972, p. 73) states: "When trips are very short, the friction of distance depends on how disagreeable or enjoyable the travel is."

Distance is not the only factor affecting recreational travel. Mueller and Gurin (1962(determined that two factors, income and availability of a paid vacation, are by far the most important determinants of outdoor recreation and at present the gereatest barrier to expanded use is financial. Outdoor Recreation Resources Review Commission Study Report 20 (1962, p. 9) states: "Many people desire to engage in more outdoor recreational activities, but they are prevented so primarily by lack of time and to some extent lack of money." "Generally people who travel further pay more for a given experience than those traveling a shorter distance to the same facility" (O'Rourke, 1974, p. 145).

Socioeconomic and ethnic characteristics of users also play a major role in recreational travel. A number of studies have sought to ascertain the effects that socioeconomic and other variables have on recreational trip making (O'Rourke, 1974). Age, number and age of children, and

income are just a few of the characteristics of users that have been studied. According to Stutz and Butts (1976, p. 167):

> In analysis of personal travel, a common assumption is that the "principle of least effort" is operationally valid. However, when the trip purpose is purely discretionary in nature, as a recreational trip, other factors enter the evaluation process.

River Recreation Travel

Travel behavior is known to be activity specific (O'Rourke, 1974). River recreation travel is much more seasonal than some other types of recreation. Also, it can be directly identified with a particular socioeconomic class. For example, Hecock (1977) has concluded that rivers tend to have a considerable season-to-season variability in use. Holiday weekends, such as Memorial Day, the Fourth of July, and Labor Day, may account for as much as one-quarter the total annual use of some rivers. Also there are predictable weekly and daily rhythms of river use. Hecock (1977) also points out regional differences in recreation. Rivers with the greatest use pressures are located near large concentrations of population in the Midwest, the East, and close to the Pacific Coast. Kalnicky (1976) found in his study of some Wisconsin streams that 63 percent of the users traveled no more than five miles from their homes. Fleaner (1968) concluded in his study of Pool Twenty-One on the Mississippi River that 95 percent of the users traveled 25 miles or less, and that the remaining five percent were either on through trips or on intermediate stops. In his

study of the Platte River in Missouri, Fleaner (1976) states that recreational users for the Platte River did not travel great distances. About 67 percent traveled 25 miles or less and 31 percent traveled no more than 50 miles. Also, 98 percent of recreationalists for the Platte River were natives of Missouri. The heavy use of the Platte River by recreationalists is due to the proximity to Kansas City and St. Louis. Hecock (1977) reported that people who are likely to canoe are likely to be engaged in professional or technological occupations, to be well educated, and from higher income groups.

Exploratory Study of the Problem

The primary purpose of this study is to analyze and describe hinterlands of users for six central U.S. rivers. More specifically the research will describe the sizes and shapes of hinterlands as well as the specific attributes of hinterlands. By examining results of the study, a model can be developed to measure drawing ability and identify travel characteristics of users attracted to various types of rivers.

It is anticipated that sampled users will show a great variation among the rivers. The variations are expected to be related to size, shape and population characteristics of the hinterlands. Rivers may also act as intervening opportunities for each other, thus reducing the movement of river users from certain directions.

Recreational travel varies with the type and availability of the resource. Travel to rivers is no exception. and some rivers are capable of attracting users from a greater distance and through stronger barrier than others. The factors that distinguish these rivers is not exactly known. Water based recreation is increasing, and information on user characteristics is essential for planning and management purposes.

In this study three objectives will be accomplished:

1) River travel patterns will be described, and the differences between the six study rivers will be determined.
2) The travel patterns will be assessed in light of an existing models of recreation travel behvior.
3) Factors which are responsible for different travel pattern configurations to different rivers will be identified.

The distance decay or gravity model approach is a simple attempt to treat two basic factors affecting the amount of flow or interaction, between any two points: population and distance. The greater the population of the two centers, the the greater the interaction; the greater the distance the less the interaction (Taaffe, 1973). There are a number of barriers to recreation travel such as time and money, but distance may be the most important.

This study should aid those interested in recreation planning and management as well as provide a foundation for further studies.

Description of Study Area

Six rivers were selected for this study because of their ideal location and proximity to each other and also because of the amount of data that could be readily collected.* The study rivers are located within close enough proximity to each other that they could act as intervening opportunities to each other. Also the locations are ideal because of the surrounding population centers, both small and large, in respect to population. The six rivers include the North Fork, Eleven Point, Current, and Big Piney Rivers of Missouri, the Illinois River of Oklahoma and the White River in Arkansas.

The North Fork River is located in east central Missouri, fifty-five miles northwest of St. Louis. The river starts two miles south of Bowling Green and runs some forty-five miles until it joins the West Fork River north of Troy.

The Eleven Point is in the south central part of the state where it flows through the Mark Twain National Forest and finally into Arkansas. The river stretches approximately 130 miles and lies 120 miles east of Springfield. Forty-four miles of the Eleven Point is included in the National Wild and Scenic River System.

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*Glover Creek in southeast Oklahoma was also chosen for this study but was later dropped because of the lack of data.

The Current River lies some forty miles east of the Eleven Point and also flows through the Mark Twain National Forest and then into Arkansas. A portion of the Current River is included with the Ozark National Scenic Waterways. It flows approximately 137 miles.

The Big Piney River is approximately 75 miles long and starts just north of Devil's Elbow and finally runs into the Eleven Point north of Cabool. It is located fifteen miles west of the Eleven Point and flows through the Clark National Forest.

The Illinois River is located in the northeast part of Oklahoma and is 60 miles east of Tulsa. The river flows out of Lake Francis in Arkansas and flows approximately 66 miles until it ends at Tenkiller Reservoir in Oklahoma. The Illinois River is designated as an Oklahoma state scenic river.

The White River of Arkansas is situated 115 miles east of Tulsa and 135 miles northwest of Little Rock. It flows out of Bull Shoals Reservoir for some 90 miles until it joins the Black River in the eastern part of the state.

Although six rivers were chosen for this study there are several other rivers in the same general area that are also major recreation rivers. As examples, the Gasconade River in central Missouri is presently under study for the National Wild and Scenic River System. The Kiamichi River in southeastern Oklahoma is also a major recreation river. Figure 2, shows the six study rivers as well as other major

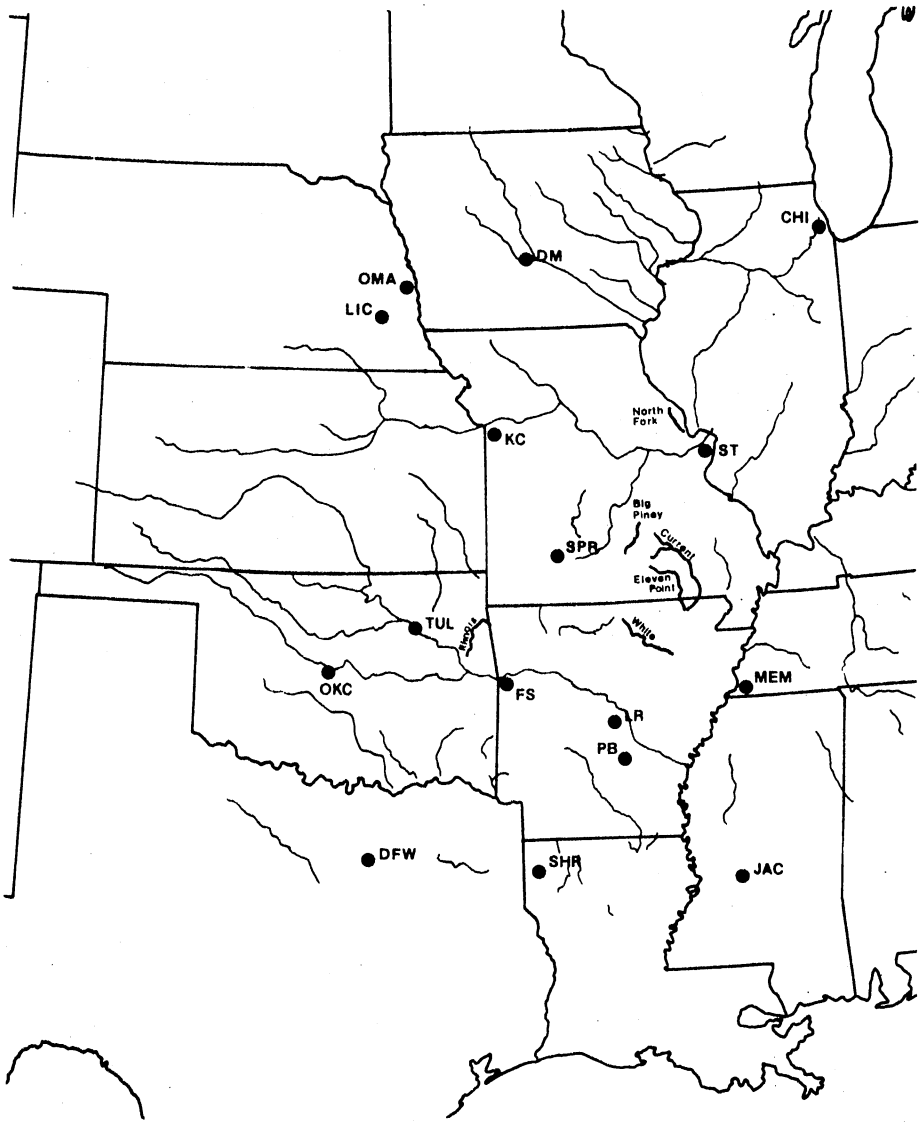

Figure 2. The Study Setting: State Boundaries Along with Major Recreation Rivers in the Area

recreation rivers in the area.

Included in Table II is a summary of the study rivers along with some of their physical and usage characteristics.

The second chapter in this study deals with the methodology and with the statistical analysis of sampled data. Chapter III contains comparison of data and findings to 'RECSAD', an existing model of recreation travel. Chapter IV deals with conclusions of the study.

TABLE II

CHARACTERISTICS OF STUDY RIVERS

River	Manager	Usage	Recreation Type	Access Characteristics
Big Piney	State	Medium/Heavy	Canoeing, Some Fishing	Limited Access-Egress
Current	National Forest Service	Medium/Heavy	Canoeing, Boating, Fishing	Limited Access-Egress
Eleven Point	National Forest Service (Wild and Scenic River)	Heavy	Canoeing, Boating, Some Fishing	Limited Access-Egress
Illinois	Local Special District (State Scenic River)	Heavy, Weekend and Summer	Canoeing, Some Boating, Some Fishing	Unlimited Access-Egress
North Fork	National Forest Service	Medium/Heavy	Canoeing, Some Fishing	Limited Access-Egress
White	National Forest Service	Medium, Weekend and Summer	Canoeing, Many	Multiple Access-Egress

CHAPTER II

METHODOLOGY

This chapter pertains to the methodology used, in particular the data collection process and data analysis. Table III shows a breakdown of the methodology used and any comments that might apply.

It was determined that for this study river user's home postal zip codes would be used as indicators of visitor origins. Zip codes are easily obtained and can be used readily as inputs to a computerized data file. The data were collected for each of the study rivers by one of the four methods.

Collection of Data

In July, 1978, the author visited the Current River and the Eleven Point in Missouri. Using records kept at the U.S. Forest Ranger station at Winona, a systematic stratified sample of "one-in-twenty" of user permits for user zip code data were extracted. For the Eleven Point River 301 users in 1977 and 114 users in 1978 were sampled. For the Current River 290 zip codes were collected from 1974 permits. These years were sampled because it was the latest available data.

TABLE III

SUMMARY OF PROCEDURES

Step	Procedure Description	Comments
1	Obtain zip codes from sampled rivers	Six rivers used; Sample size ranged from 49-400
2	Determine latitude and longitude for each zip code	Utilized 'PICADAD' tape provided by U.S. Census Bureau
3	Compute distance between user zip code and river resource	Utilized 'RECDIST' program developed by Dr. Stephen Tweedie
4	Summarize distance characteristics for users by river	Utilized Statistical Analysis Systems; mean, median, histograms
5	Map origins of users by river	Utilized 'FLOWPLOT' program
6	Determine per capita use rates of rivers by three digit zip code areas	
7	Analysis of hinterlands of rivers by shape, size and characteristics	
8	Comparison with models of recreation travel behavior	'RECSAD' model compared with sampled data
9	Summary	

Also in July, 1978, the author visited the White River in Arkansas. Here it was intended to obtain zip code data by personal interviews. One member in each family or group was interviewed along various access points of the river. The majority of the interviews were taken below the Arkansas State Highway 62 at Cotter. A total of 49 interviews were obtained over a four day period.

Zip code data were obtained for the Big Piney and the North Fork Rivers in Missouri from personnel of the North Central Forest Experiment Station. For the Big Piney River, 398 zip codes were obtained to be used in the study. For the North Fork River, 259 zip codes were sampled on a systematic basis from 2274 responses. These data had been gathered as part of a major Forest Service study of river users.

Three hundred and twenty zip codes were collected by sampling data on the Illinois River. Samples were taken at various access points along the river in the summer of 1978 as part of a study of use patterns for that river.

Identification of User Hinterland

To determine geographic coordinates of the user zip code and the river resource the computer tape 'PICADAD' was used. This particular tape contains a list of place names and their associated geographic codes.

'RECDIST', a computer program developed by Dr. Stephen W. Tweedie, enabled travel distances between origin and

destination for each river to be calculated. For purposes of the analysis, distances were measured from the center of the three zip code areas to the point where contact had been made or access point of the river. Table IV shows selected characteristics of origin and travel behavior for each river. The table provides evidence that there is clearly a distance decay relationship for all rivers except the Illinois. This is shown by the mean value being higher than the median and also by the relatively high positive skewness. The Illinois River also shows a positive skewness, indicating distance decay, but in this case the median is greater than the mean value. This is caused by a bimodal pattern than can be seen in Figure 3. This type distribution is caused by the locations of Tulsa and Oklahoma City with respect to the river.

Origins were grouped by concentric distance zones around the river resource or the survey area and percentages were calculated for each category (Table IV). These show high and low uses for particular areas as well as percent coming from that zone.

The Big Piney River as seen by the flowmap (Figure 4) is almost entirely influenced by population centers to the north of itself.* It draws the majority of users from three

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*Origins with only one user were excluded from all flowmaps except for the White River in order to clarify the patterns. These accounted for less than eight percent of all users.

TABLE IV

USE CHARACTERISTICS BY RIVER

River	N	Mean	Median	Skewness	Percentage Traveling by Zone in Miles					
					0 to 50	51 to 100	101 to 150	151 to 200	201 to 250	250
Big Piney	398	166	127	4.32	27	2	43	8	13	9
Current	290	187	141	6.27	2	7	57	9	10	15
1977 11-Point	301	196	166	3.18	5	6	16	40	9	23
1978 11-Point	114	214	170	4.84	2	9	19	39	4	28
Illinois	320	151	165	4.51	16	12	17	29	21	7
North Fork	259	230	203	4.67	8	6	5	29	33	18
White	49	97	28	3.29	53	10	20	6	2	8

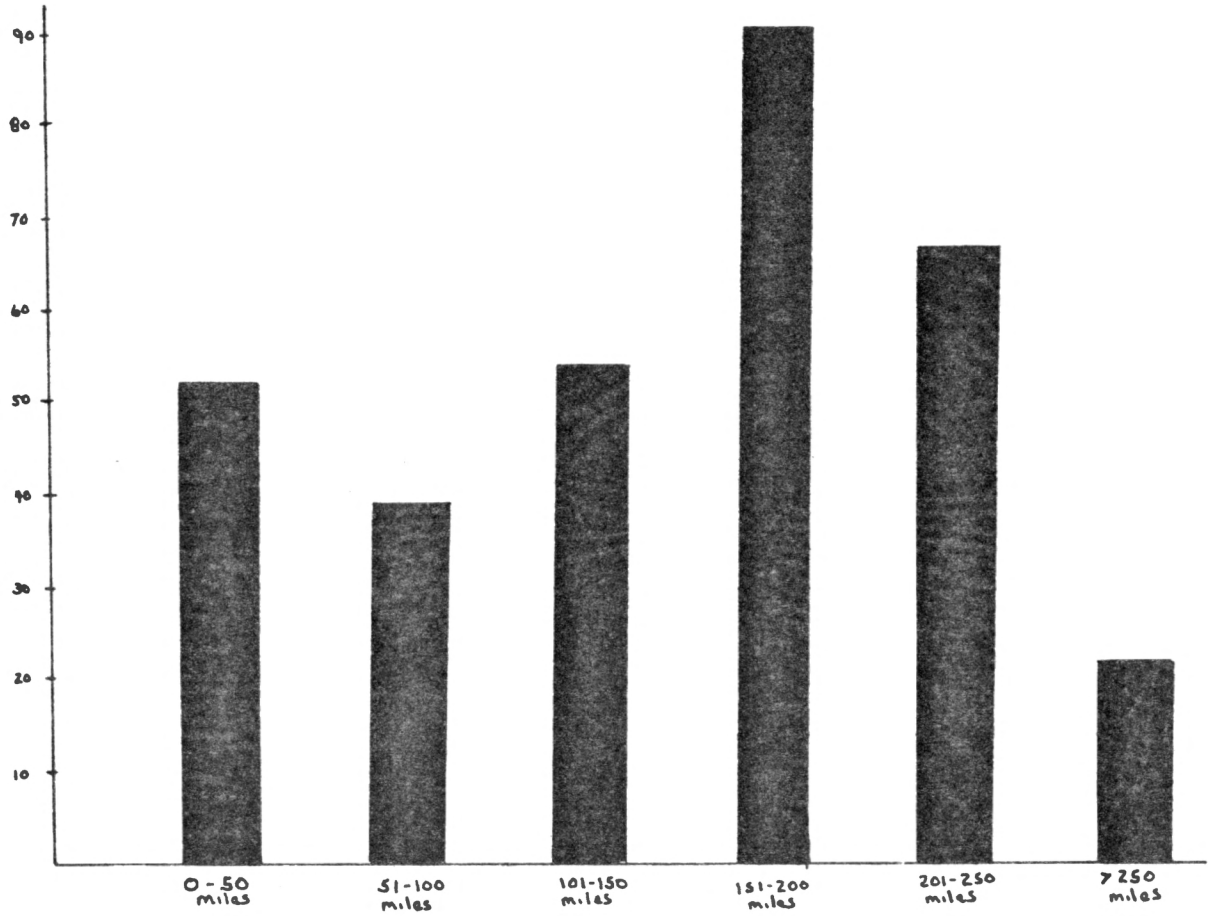

Figure 3. Distribution Graph of the Illinois River

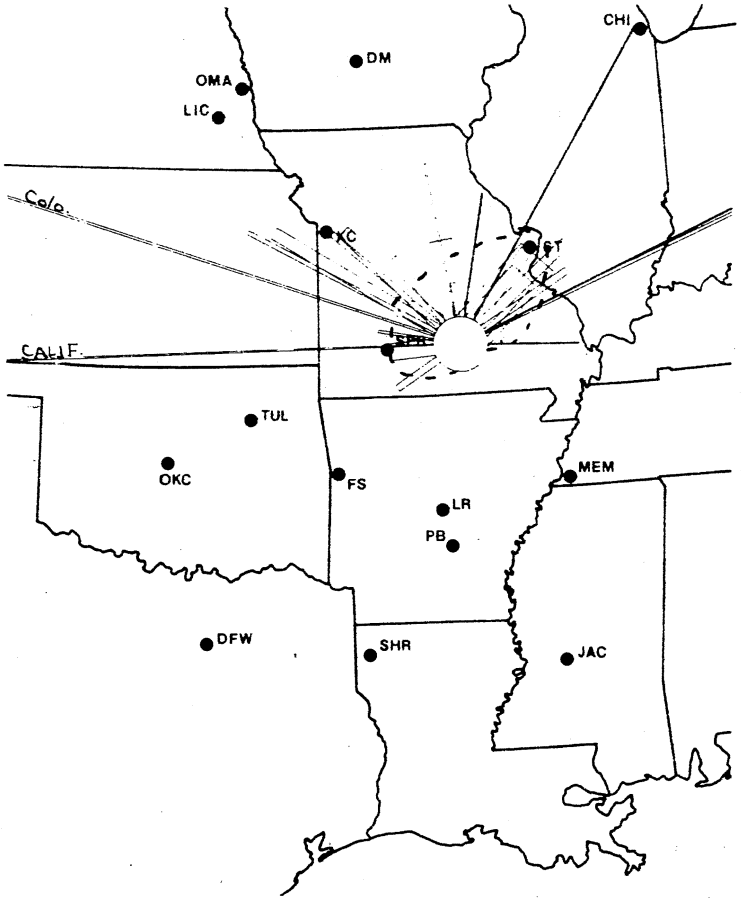

Figure 4. Big Piney River Observed Travel

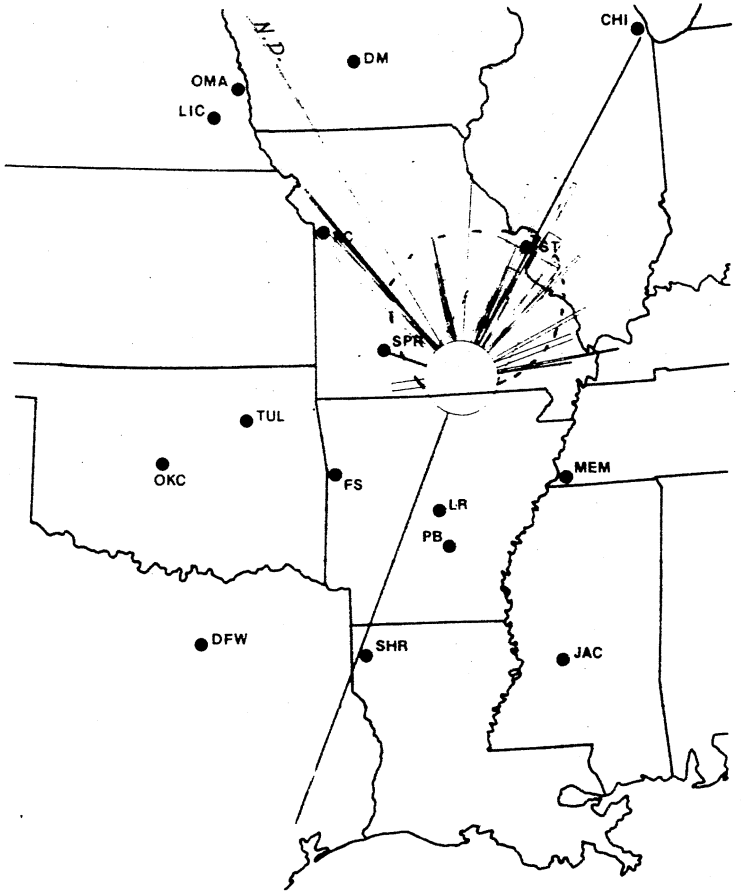

Figure 5. Current River Observed Travel

major population centers, St. Louis, Columbia, and Kansas City. The flowmaps also show that the Current River, the Eleven Point River, and the White River seem to act as intervening opportunities, reducing the flow of users from the south.

The Current River attraction as seen in the flowmap (Figure 5) has travel characteristics of users very similar to the Big Piney River. It is greatly influenced by the Eleven Point and White Rivers as intervening opportunities. Like the Big Piney, the Current River draws the majority of its users from major population centers, especially St. Louis and Kansas City. The Current River receives relatively few users from Columbia probably in part because the Big Piney River is much closer and presumably intercepts potential users.

The Eleven Point River for both 1977 and 1978 data show that four major population centers, St. Louis, Kansas City, Springfield, and Memphis, make up the majority of users (Figures 6-7). Columbia also adds a large number of users to the Eleven Point probably because it is not in such a direct line with the Big Piney as is the Current River. The Eleven Point draws users through the Current River to the east indicating that the Current River does not act as a very strong intervening opportunity for this particular river. Again the White River restricts flow from the south.

The Illinois River is an excellent example of rivers acting as intervening opportunities for each other (see

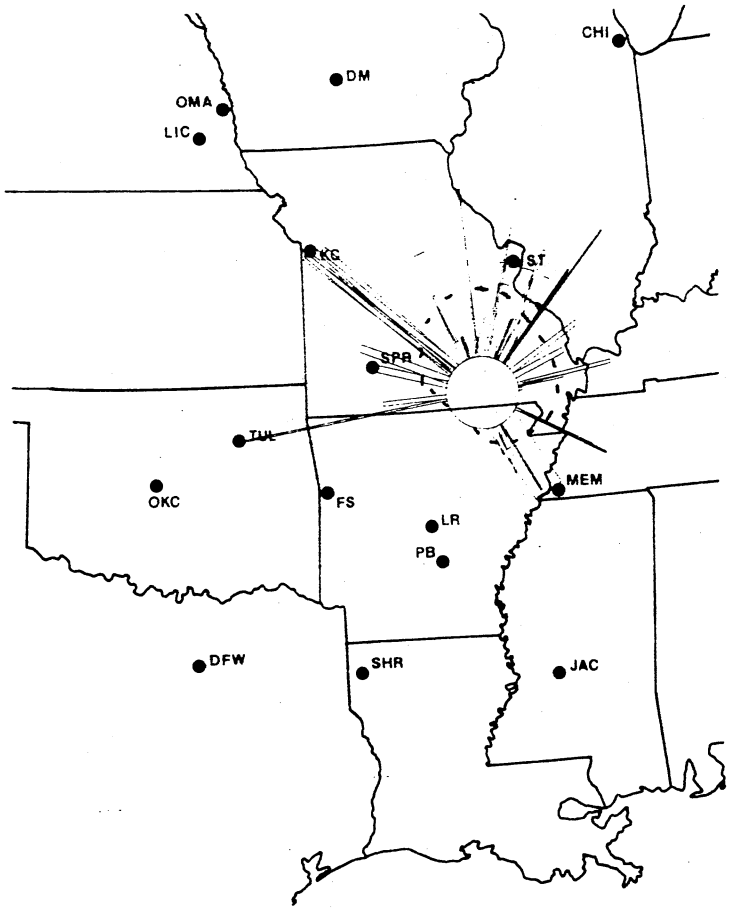

Figure 6. 1977 Eleven Point River
Observed Travel

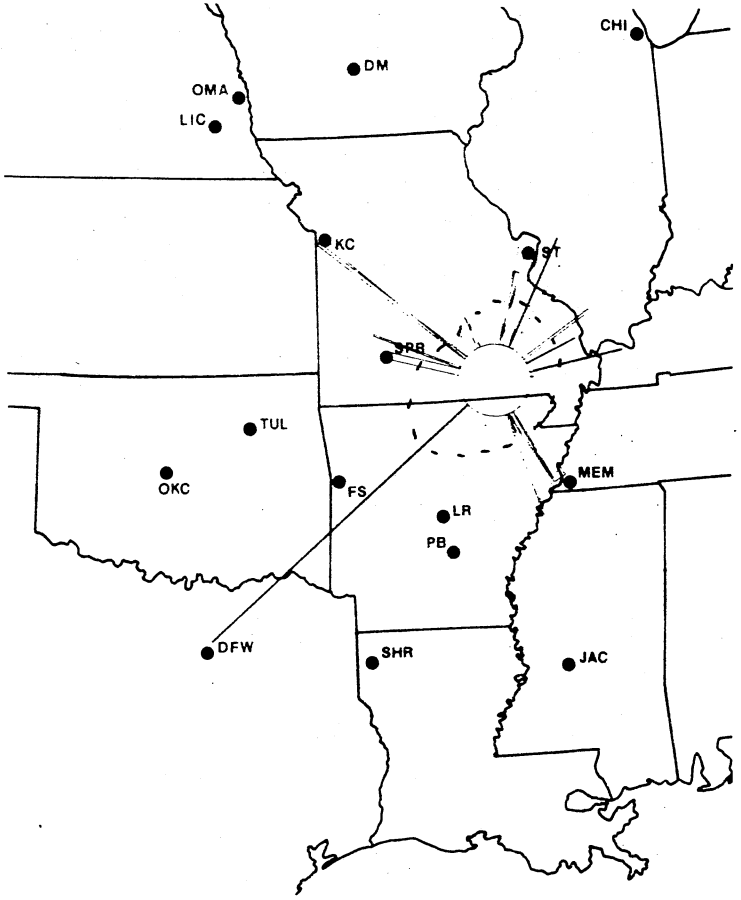

Figure 7. 1978 Eleven Point River
Observed Travel

Figure 8). The Illinois River receives the majority of its users from three major population centers, Tulsa, Oklahoma City, and Bartlesville all located to the west of the river. No major usage is shown coming from the northeast.

The North Fork River is the first to deviate from trends established by other rivers (Figure 9). Although it is located relatively close to St. Louis it draws only a small percentage from there. Instead the majority of its use comes from Kansas City and especially Springfield to the south. Also, some users bypass the Eleven Point and Current River from Memphis. The North Fork also had the largest mean and median values of all study rivers which would indicate it is capable of drawing users from greater distances.

The White River as seen in Figure 10 had the majority of its users come from within 50 miles of the river (Table V). Since the White River is located to the south of the other study rivers it draws most of its users from locations to the south of the river. This particular river was not greatly influenced by other rivers since it had users coming from Springfield and Kansas City. The White River also had by far the shortest mean and median distance travled. This is due in part to the fact that the White River is more of a fishing resource than a canoeing resource and it is assumed that users are willing to travel greater distances for a given resource. Also the White River had the least amount of user data which possibly did not get a chance to show some

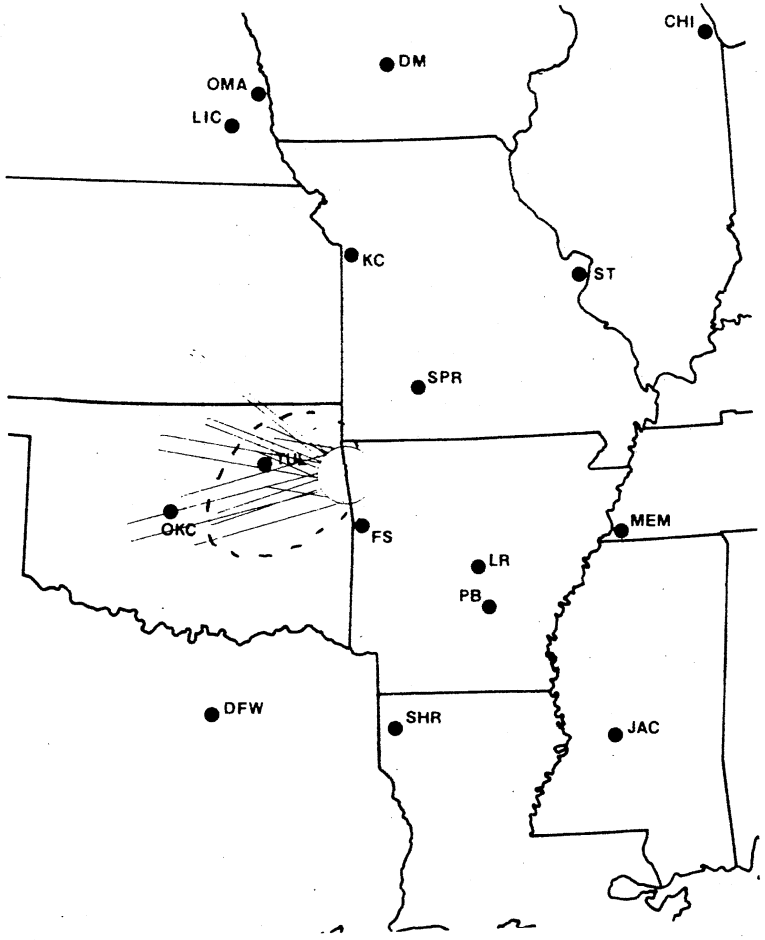

Figure 8. Illinois River Observed Travel

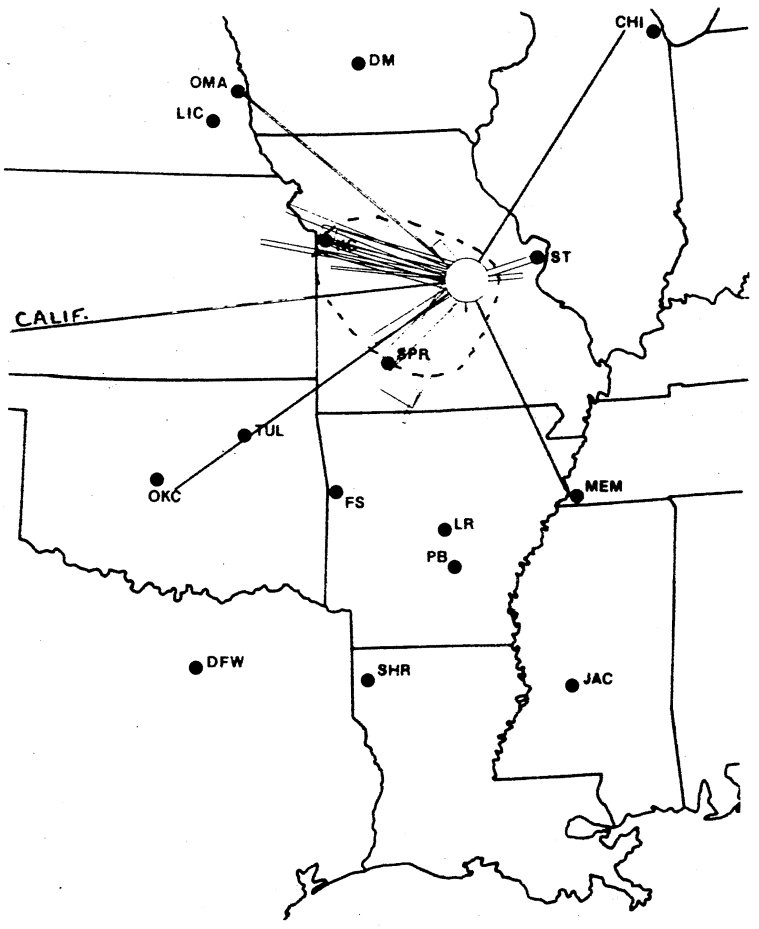

Figure 9. North Fork River Observed Travel

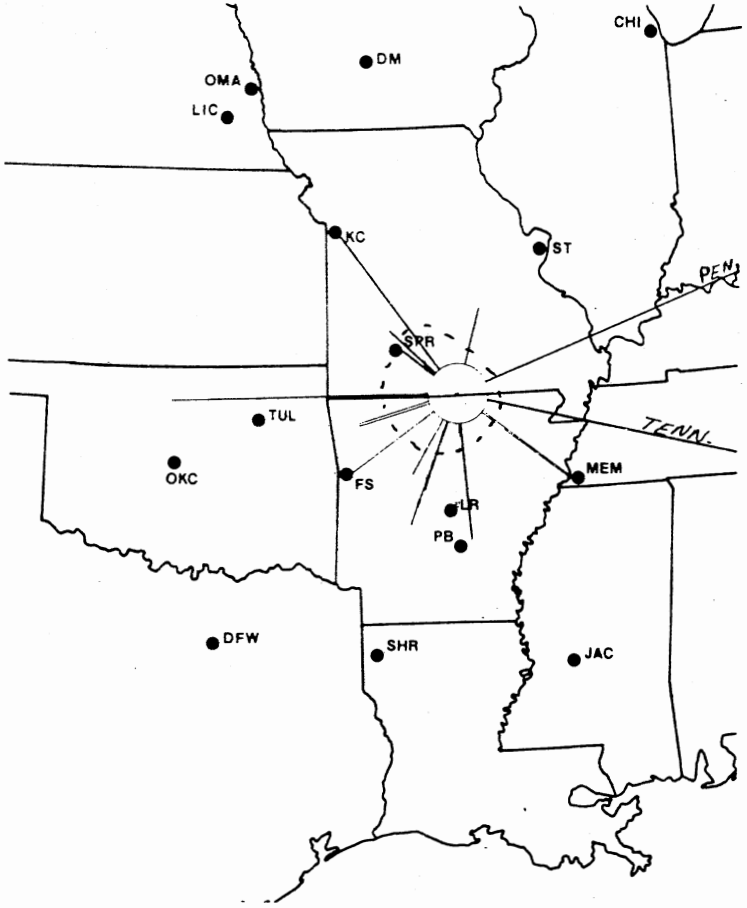

Figure 10. White River Observed Travel

TABLE V

PREDICTED AND EMPIRICALLY DETERMINED
TRAVEL BEHAVIOR OF RIVER USERS
FOR SIX STUDY RIVERS

Miles Traveled	Six Study Rivers Percent of Total Users Empirical Data	RECSAD Predictions
0 - 50	13.2	6.8
51 - 100	6.6	19.8
101 - 150	27.8	22.5
151 - 199	22.8	20.5
200 - 249	15.0	14.6
250 and over	14.5	8.7
N =	1730	2775

of its long distance users.

Each river hinterland is projected for each river by hashed line. The hinterland was determined by the river resources drawing area of users. The major areas which supplied users to the river was the intention. Long distance users were not totally excluded in the hinterland although it was expected that many of the cases were pass-through tourist instead of long distance recreationist.

The river data was also examined based on direction of

travel according to a four quadrant system: northwest, northeast, southwest and southeast.

The Big Piney River has practically all of its use coming from the two northern quadrants. Between the two northern quadrants the northeast, possible because of St. Louis, had the most usage. The Current River had about the same configuration but with fewer users coming from the northwest quadrant. For both rivers few users come from the northwest quadrant. For both rivers few users come from the southwest quadrant and even fewer from the southeast quadrant.

For the Eleven Point River both the 1977 and 1978 data results are the same. Again the majority of usage comes from the two northern quadrants and few from the south. St. Louis in the northeast quadrant supplies the majority of use. The major difference between the Eleven Point and the two rivers mentioned above is that the southeast quadrant receives few users and the southwest quadrant even less.

The Illinois River has the majority of its users coming from the two western quadrants. The eastern quadrants have relatively few users especially the northeast quadrant.

The North Fork River like the Illinois River has the majority of its usage coming from the western quadrants. The two eastern quadrants are made up mainly by usage from Memphis and Chicago.

The White River has the most equally distributed usage in each quadrant than any other river. Although the majority of users come from the two southern quadrants.

In summary, basically there are two general shapes of user hinterlands, normal and skewed. An example of skewed would be the Illinois River where the majority of users come from two quadrants and few from the others. This could be obtained from large population centers as with the case of Tulsa and Oklahoma City to the Illinois River or from intervening opportunities. The normal distribution is represented by the White River where for the most part users are equally balanced from all four quadrants.

Out of State Users

In general, the major usage for each particular river comes from within the state where the river is located. Table V shows the percentage of out of state users by river. Values ranged from 82.67 percent to 49.12 percent for users located in the state. The Current River in southeastern Missouri has the largest percentage of users coming from another state with 24.0 from Illinois. This shows that users might be affected by state boundaries. These results basically agree with earlier studies (Kalnicky, 1978; Fleener, 1968) that also found the majority of users coming from within the same state as the river resource.

CHAPTER III

COMPARISON WITH EXISTING MODEL

Several models have been developed to try and simulate recreational travel. These range from very simple theories such as the distance decay concept to very complex inertia models, all of which basically look at the same variables.

This chapter will examine the actual sampled data against the 'RECSAD' model. Strengths and weaknesses will be discussed.

'RECSAD' Model

A computer program, 'RECSAD', which stands for recreation supply and demand (Tweedie and Hecock, 1976, 1979) is an attempt to simulate travel behavior and predict recreation demand.

Characteristics of the program include determining the study area and control of a number of variables. For the study area zip code areas within an approximate 200 mile radius of the study rivers were used as demand points (see Figure 11). All major recreation rivers within a 300 mile radius of the study rivers were also included in the study area in order to compensate for the boundary problems by providing alternative opportunities.

Figure 11. Population Centers (3-Digit Zip Code Regions)

The particular variables which will be controlled are participation rate per 100,000 population and percent willing to travel the median distance. In this case the percent willing to travel the median diatance between the population centers and the river resource. It could also be used to simulate changes in travel costs or willingness to travel. Output data was plotted similar to that of the sampled data. Five different 'RECSAD' runs were made varying the participation rate and percent willing to travel median distance. The goal was to try and derive a predicted flow similar to that of the sampled flow and compare them. 'RECSAD' run number five produced the closest fit to the sampled data and therefore was used in the comparison. 'RECSAD' runs one through five for the Eleven Point River can be seen in Appendix A.

In order to assess the ability of 'RECSAD' to provide reasonable prediction of flows, comparisons were made between actual and predicted flows for selected population centers and each study river (Table VI).

The predicted flows of 'RECSAD' and the sampled flows differ substantially from each other but in some instances there were some general similarities.

For the most part 'RECSAD' tended to overestimate use except in the case of large population centers. Their usage was very heavy and usually made up the majority of total usage for the river. Also, the problem of intervening opportunities was not properly handled by 'RECSAD'.

TABLE VI

ACTUAL AND PREDICTED FLOWS BETWEEN SELECTED POPULATION CENTERS AND STUDY RIVERS

(% of Total River Use From Selected Population Centers)

River	Memphis, (TN)	Batesville, (MS)	St. Louis, (MO)	Doniphan, (MO)	Kansas City, (MO)	Little Rock, (ARK)	Tulsa (OK)
Big Piney							
RECSAD #5	4.5	1.0	10.3	.8	3.3	1.2	1.4
Actual	0	0	14.8	0	1.5	0	0
Current							
RECSAD #5	7.06	1.77	7.95	.9	2.4	2.0	1.6
Actual	3.6	0	31.7	1.4	5.1	0	.3
11-Point							
RECSAD #5	8.2	1.9	8.9	.9	1.7	1.7	.7
Actual	14.4	2.4	14.5	1.4	5.3	0	1.0
Illinois							
RECSAD #5	2.8	1.0	2.3	.3	3.8	2.0	4.4
Actual	0	0	0	0	.1	.6	18.1
North Fork							
RECSAD #5	1.8	.4	13.9	.5	4.2	.4	.7
Actual	.8	0	3.5	0	13.9	0	0
White							
RECSAD #5	6.7	1.8	6.1	.7	2.6	2.3	2.1
Actual	4.1	0	0	0	0	8.2	0

On the other hand, 'RECSAD' did a good job of predicting flows from small population areas. The plotted flows of 'RECSAD' can be seen in Figures 12-16. A cutoff value was assigned to users and bars were scaled to clarify the map by showing only the major flows.

Summary tables were created for each 'RECSAD' run and compared to the sampled data for selected population centers (Appendix B).

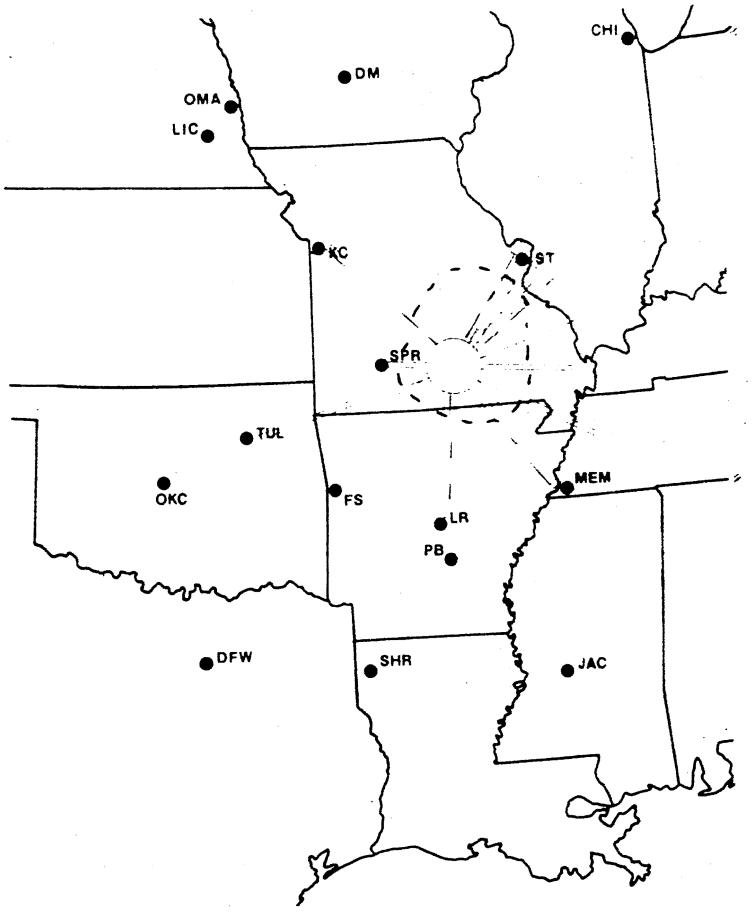

Figure 12. Big Piney River Predicted Travel

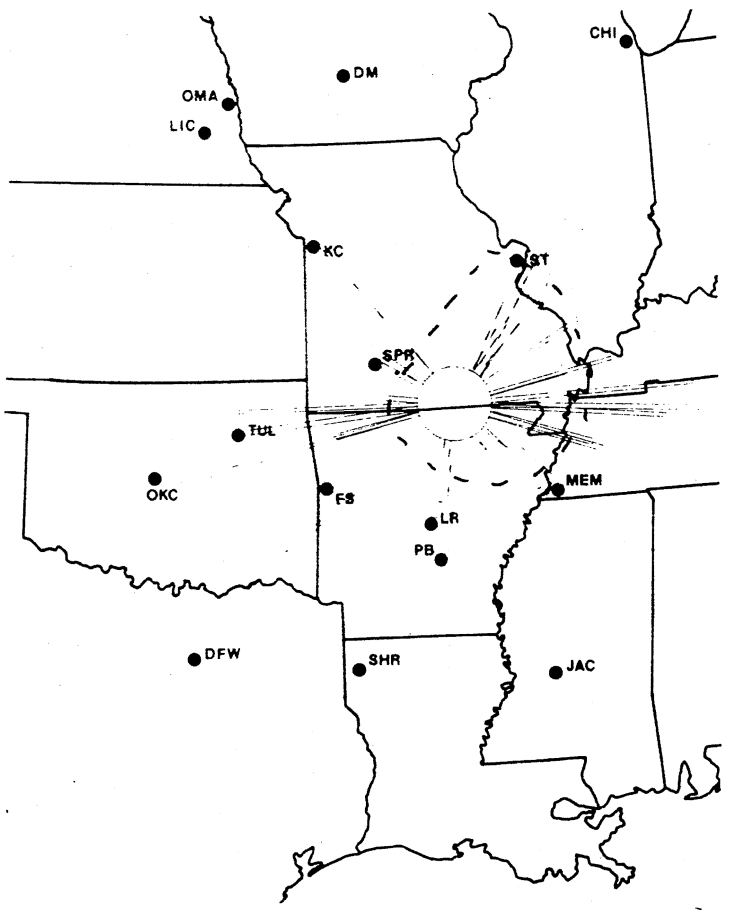

Figure 13. Current River Predicted Travel

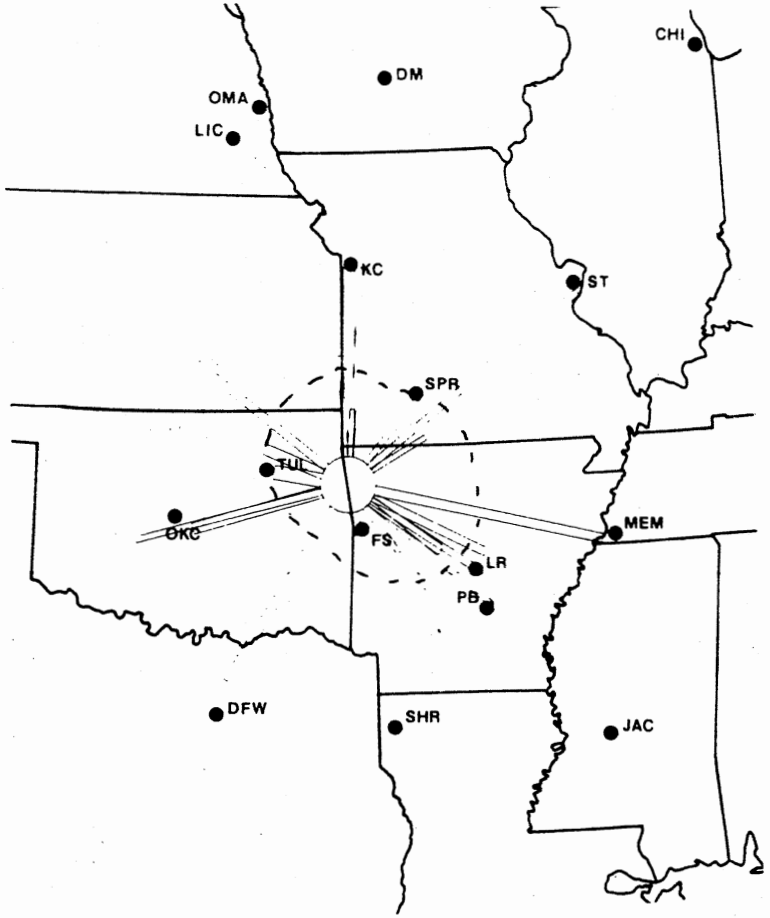

Figure 14. Illinois River Predicted Travel

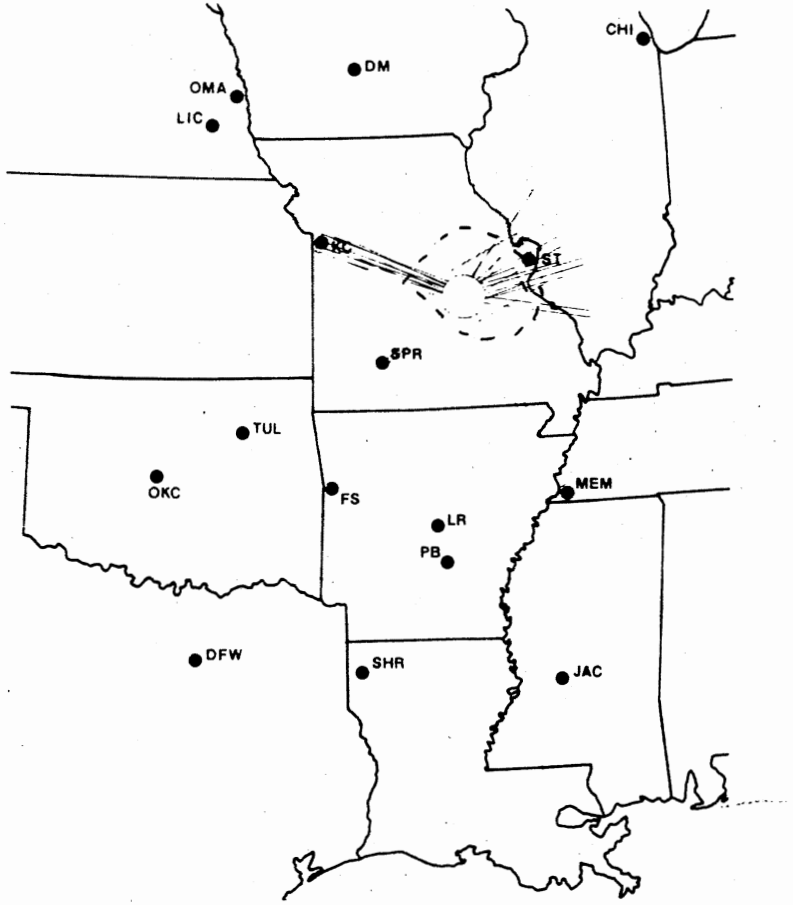

Figure 15. North Fork River Predicted Travel

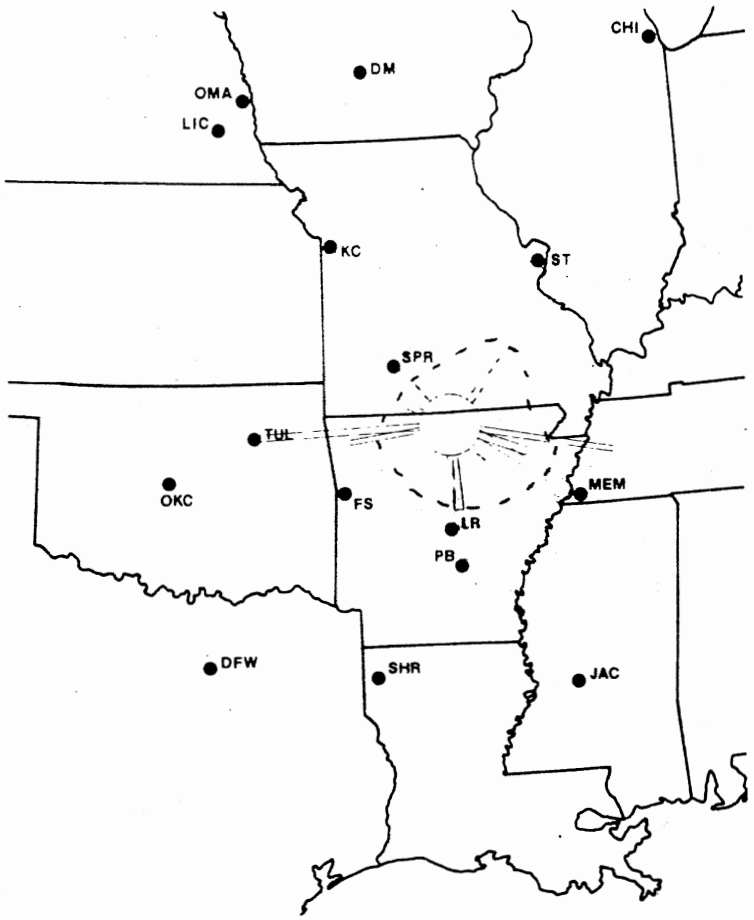

Figure 16. White River Predicted Travel

CHAPTER IV

SUMMARY AND IMPLEMENTATIONS OF STUDY

In this chapter, results of the analysis are summarized and conclusions presented.

Data Results

From the results of this study several significant findings were made that could be applied to other recreation rivers.

Regarding the shape of hinterlands it was found that there are basically two general shapes, skewed and normal. Shape of hinterland is greatly affected by nearby population centers and by other rivers acting as intervening opportunities.

Size of hinterland was found to be in relation to some function of the river. For example, the more spectacular the river the larger the hinterland. This can be seen in the White River which has a small hinterland probably because it is not a well known recreation or canoeing river, at least not on a large scale. On the other hand, the North Fork River had a large hinterland because it is a more "well known" river.

State boundaries also seemed to play a major role with users. The majority of users come from within the state where the resource is located.

Although local use was found to be heavy in this study it did not seem to be as heavy as reported in earlier studies. For all the study rivers the average distance traveled was 177 miles indicating some long distance users. Although long distance users might very well be just pass-through tourist instead of long distance recreationist.

In comparison to a travel behavior model, 'RECSAD', it can be seen that this could become an important tool for predicting usage in the future.

From the data and results above and in earlier chapters it is possible to make a visual summary of the results. With slight modifications it could be easily applied to other recreation rivers. Some major characteristics of the model would be, other rivers acting as intervening opportunities, heavy local usage, heavy usage coming from nearby major population centers and a distance decay relationship. Figure 17 shows the visual summary. A similar model was created by Thomas Doering in 1977.

Application of Research

This study should aid recreation planners and managers in solving one of the most basic questions asked about recreation travel behavior -- where do the users come from? Hopefully, similar studies addressing other aspects of

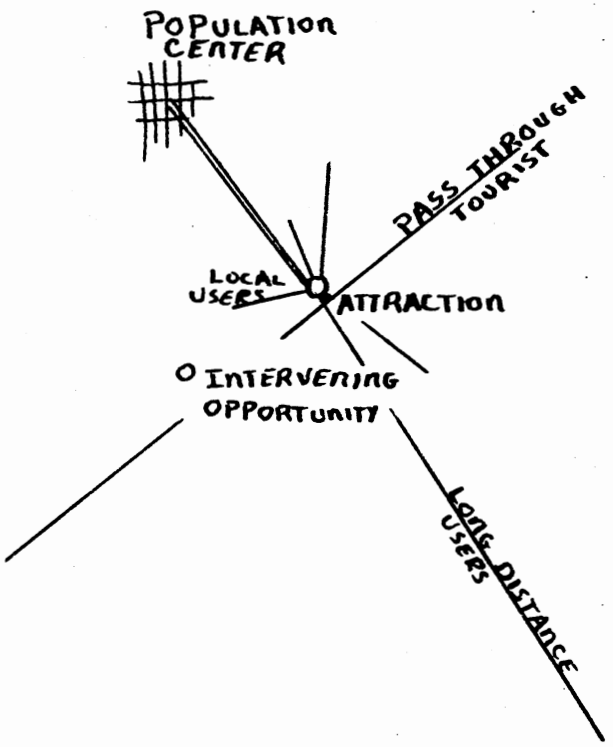

Figure 17. Visual Model of Observed Findings

recreation can be made and when results are combined specific questions can be answered. To be totally understood other disciplines must become involved because it is definitely a multidiscipline activity. One further research study would be for a similar study to be made in another region of the U.S. and compare results to see if travel behavior changes from one region to another.

The results of this study could be compared against several recreation travel models to test their validity. Also, each state recreation planning agency could prepare this type of study for their rivers and come up with recreation travel models by state.

A better understanding of our environment and especially our resources is needed. The overall goal is to obtain the most good for the greatest number of people and hopefully this study has taken us one step closer to that.

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APPENDICES

APPENDIX A

FLOWMAPS OF ELEVEN POINT RIVER FOR 'RECSAD' RUNS ONE THROUGH FIVE

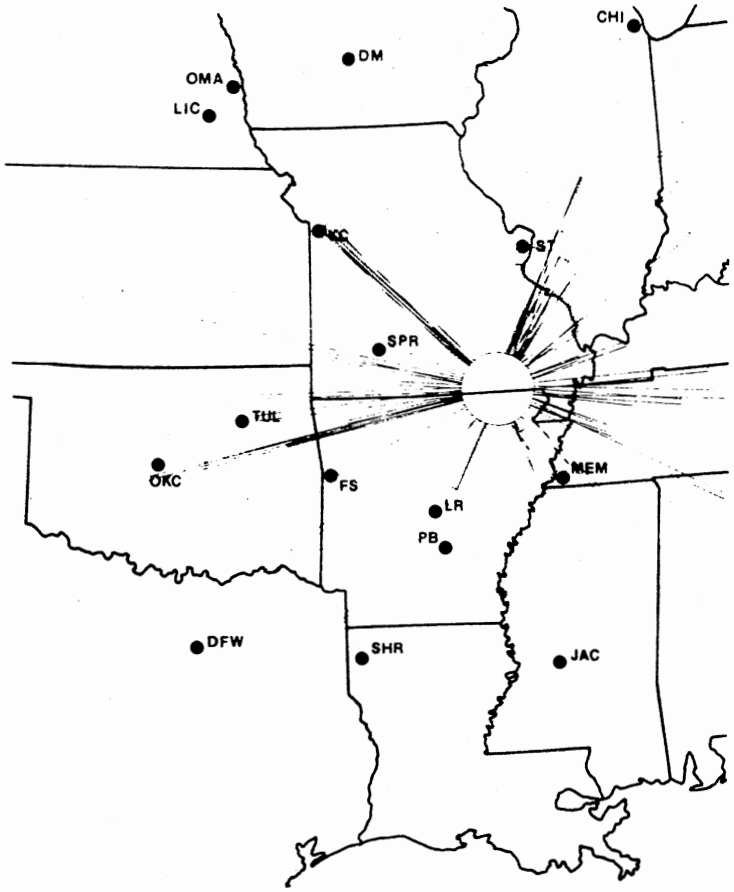

Figure 18. Eleven Point River Predicted Travel, RECSAD Run #1

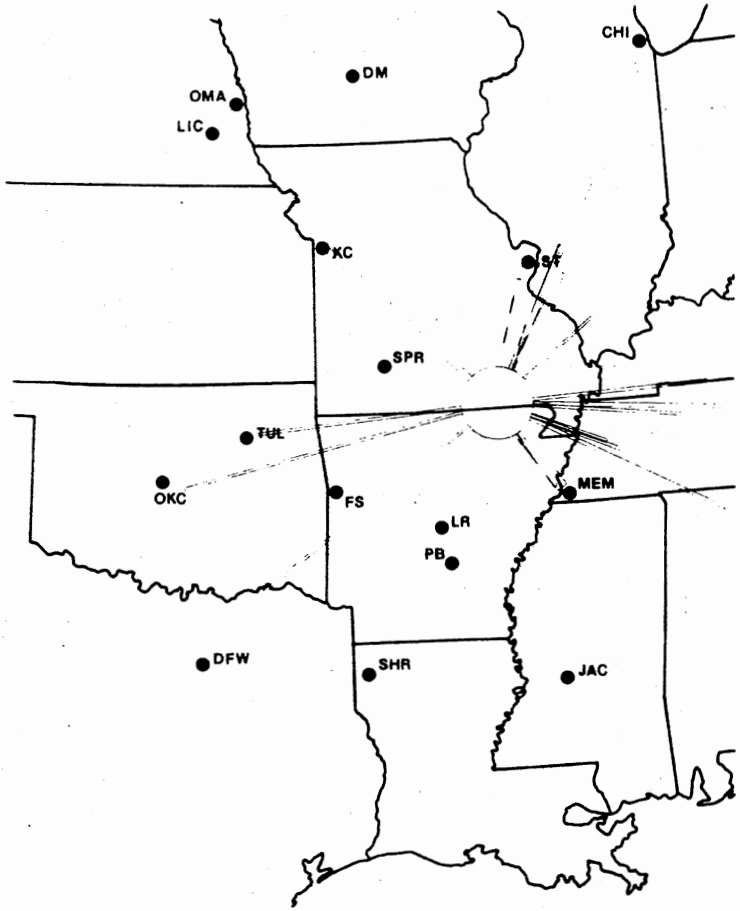

Figure 19. Eleven Point River Predicted Travel, RECSAD Run #2

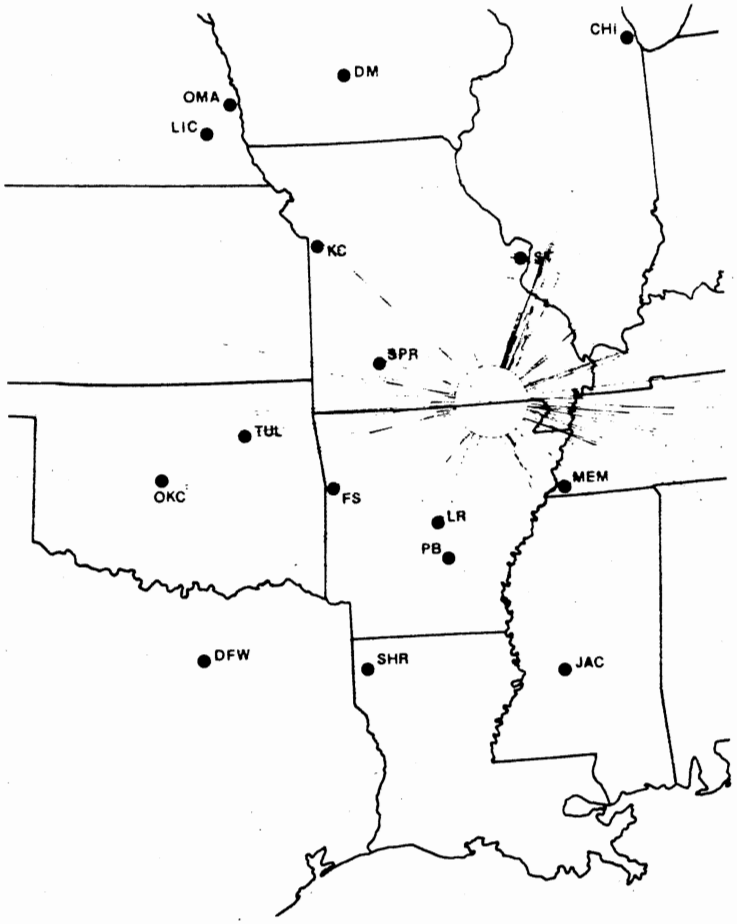

Figure 20. Eleven Point River Predicted Travel, RECSAD Run #3

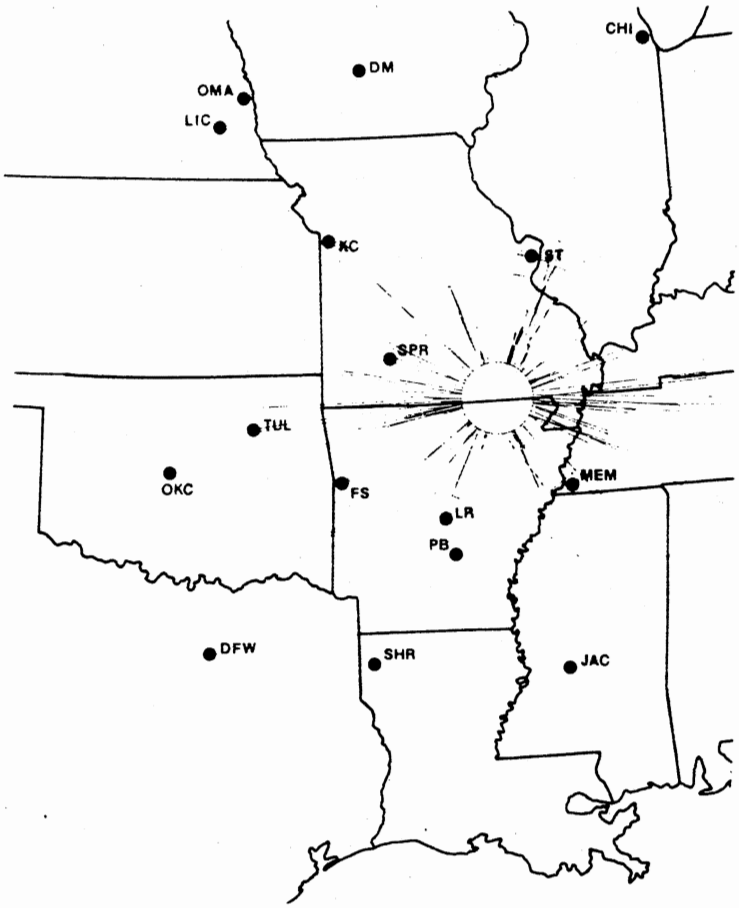

Figure 21. Eleven Point River, Predicted Travel, RECSAD Run #4

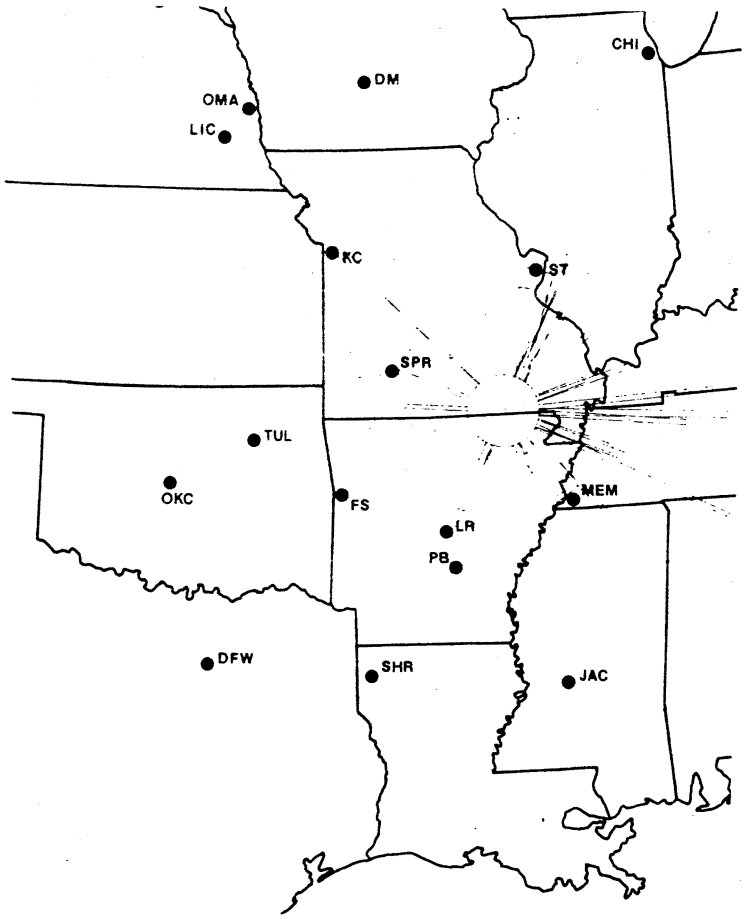

Figure 22. Eleven Point River, Predicted Travel, RECSAD Run #5

APPENDIX B

COMPARISON OF DIFFERENT 'RECSAD' RUNS TO ACTUAL DATA BY SELECTED CITIES

TABLE VII

BIG PINEY RIVER

	Memphis, Tenn.	Batesville, Miss.	St. Louis, Mo.	Doniphan, Mo.	Kansas City,Mo.	Little Rock,Ark.	Tulsa, Ok.	N
RECSAD #1	186	53	408	23	149	57	75	4939
Percent	3.77	1.07	8.26	.47	3.02	1.15	1.52	
RECSAD #2	93	26	204	11	75	24	37	2470
Percent	3.77	1.05	8.26	.45	3.04	.97	1.50	
RECSAD #3	212	52	477	30	164	55	72	5020
Percent	4.22	1.04	9.50	.60	3.27	1.10	1.43	
RECSAD #4	219	49	499	35	165	57	65	4838
Percent	4.53	1.01	10.31	.72	3.41	1.18	1.34	
RECSAD #5	22	5	50	4	16	6	7	484
Percent	4.54	1.03	10.33	.83	3.31	1.24	1.44	
Sampled	0	0	59	0	7	0	0	398
Percent	0	0	14.82	0	1.76	0	0	

TABLE VII (Continued)

CONDITIONS:	
RECSAD #1:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.25
RECSAD #2:	Participation rate (per 100,000) = 500
	Percent willing to travel median dist. = 0.25
RECSAD #3:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.10
RECSAD #4:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.05
RECSAD #5:	Participation rate (per 100,000) = 100
	Percent willing to travel median dist. = 0.05

TABLE VIII

CURRENT RIVER

	Memphis, Tenn.	Batesville, Miss.	St. Louis, Mo.	Doniphan, Mo.	Kansas City,Mo.	Little Rock, Ark.	Tulsa, Ok.	N
RECSAD #1	220	65	350	23	122	57	75	4716
Percent	4.66	1.38	7.42	.49	2.59	1.21	1.59	
RECSAD #2	110	33	175	12	61	29	37	2358
Percent	4.66	1.40	7.42	.51	2.59	1.23	1.57	
RECSAD #3	280	74	369	31	118	75	73	4723
Percent	5.93	1.57	7.81	.66	2.50	1.59	1.55	
RECSAD #4	315	77	357	37	107	85	66	4533
Percent	6.95	1.70	7.89	.82	2.37	1.88	1.46	
RECSAD #5	32	8	36	4	11	9	7	453
Percent	7.06	1.77	7.95	.88	2.43	1.99	1.55	
Sampled	0	0	92	4	15	0	1	290
Percent	0	0	31.72	1.38	5.17	0	.34	

TABLE VIII (Continued)

CONDITIONS:	
RECSAD #1:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.25
RECSAD #2:	Participation rate (per 100,000) = 500
	Percent willing to travel median dist. = 0.25
RECSAD #3:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.10
RECSAD #4:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.05
RECSAD #5:	Participation rate (per 100,000) = 100
	Percent willing to travel median dist. = 0.05

TABLE IX

ELEVEN POINT RIVER

	Memphis, Tenn.	Batesville, Miss.	St. Louis, Mo.	Doniphan, Mo.	Kansas City,Mo.	Little Rock,Ark.	Tulsa, Ok.	N
RECSAD #1	239	69	372	25	106	55	63	4727
Percent	5.06	1.46	7.87	.53	2.24	1.16	1.33	
RECSAD #2	120	35	186	12	53	27	31	2364
Percent	5.08	1.48	7.93	.51	2.26	1.15	1.32	
RECSAD #3	323	83	409	35	93	70	54	4790
Percent	6.74	1.73	8.54	.73	1.94	1.46	1.13	
RECSAD #4	379	89	407	42	78	78	45	4660
Percent								
RECSAD #5	38	9	41	4	8	8	4	466
Percent	8.15	1.93	8.80	.86	1.72	1.72	.86	
Sampled-								
1977	42	7	47	4	18	0	3	301
1978	18	3	13	2	4	0	0	114
Percent-								
1977	13.95	2.33	15.61	1.33	5.98	0	1.0	
1978	15.79	2.63	11.40	1.75	3.51	0	0	

TABLE IX (Continued)

	CONDITIONS:
RECSAD #1:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.25
RECSAD #2:	Participation rate (per 100,000) = 500
	Percent willing to travel median dist. = 0.25
RECSAD #3:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.10
RECSAD #4:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.05
RECSAD #5:	Participation rate (per 100,000) = 100
	Percent willing to travel median dist. = 0.05

TABLE X

ILLINOIS RIVER

	Memphis, Tenn.	Batesville, Miss.	St. Louis, Mo.	Doniphan, Mo.	Kansas City,Mo.	Little Rock,Ark.	Tulsa, Ok.	N
RECSAD #1	134	45	189	14	145	55	117	4090
Percent	3.28	1.10	4.62	.34	3.55	1.34	2.86	
RECSAD #2	67	23	94	7	73	28	58	2045
Percent	3.28	1.12	4.60	.34	3.57	2.69	2.84	
RECSAD #3	123	41	132	14	157	71	152	4033
Percent	3.05	1.01	3.27	.35	3.89	1.76	3.77	
RECSAD #4	109	35	94	12	155	80	172	3918
Percent	2.78	.89	2.40	.30	3.96	2.04	4.39	
RECSAD #5	11	4	9	1	15	8	17	392
Percent	2.81	1.02	2.30	.26	3.83	2.04	4.34	
Sampled	0	0	0	0	3	2	59	320
Percent	0	0	0	0	.94	.63	18.44	

TABLE X (Continued)

CONDITIONS:	
RECSAD #1:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.25
RECSAD #2:	Participation rate (per 100,000) = 500
	Percent willing to travel median dist. = 0.25
RECSAD #3:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.10
RECSAD #4:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.05
RECSAD #5:	Participation rate (per 100,000) = 100
	Percent willing to travel median dist. = 0.05

TABLE XI

NORTH FORK RIVER

	Memphis, Tenn.	Batesville, Miss.	St. Louis, Mo.	Doniphan, Mo.	Kansas City,Mo.	Little Rock,Ark.	Tulsa Ok.	N
RECSAD #1	130	34	499	26	175	29	60	5147
Percent	2.53	.66	9.69	.51	3.40	.56	1.17	
RECSAD #2	65	17	250	10	88	15	30	2574
Percent	2.53	.66	9.71	.39	3.42	.58	1.17	
RECSAD #3	118	25	667	25	214	25	51	5481
Percent	2.15	.46	12.17	.46	3.90	.46	.93	
RECSAD #4	102	19	771	27	232	21	41	5508
Percent	1.85	.34	14.00	.49	4.21	.38	.74	
RECSAD #5	10	2	77	3	23	2	4	551
Percent	1.81	.36	13.97	.54	4.17	.36	.73	
Sampled	2	0	9	0	36	0	0	259
Percent	.77	0	3.47	0	13.90	0	0	

TABLE XI

NORTH FORK RIVER

CONDITIONS:	
RECSAD #1:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.25
RECSAD #2:	Participation rate (per 100,000) = 500
	Percent willing to travel median dist. = 0.25
RECSAD #3:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.10
RECSAD #4:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.05
RECSAD #5:	Participation rate (per 100,000) = 100
	Percent willing to travel median dist. = 0.05

TABLE XII

WHITE RIVER

	Memphis, Tenn.	Batesville, Miss.	St. Louis, Mo.	Doniphan, Mo.	Kansas City, Mo.	Little Rock, Ark.	Tulsa, Ok.	N
RECSAD #1	210	65	300	21	124	61	85	4553
Percent	4.61	1.43	6.59	.46	2.72	1.34	1.87	
RECSAD #2	105	32	150	11	62	31	42	2277
Percent	4.61	1.41	6.59	.48	2.72	1.36	1.84	
RECSAD #3	261	74	286	27	120	84	89	4506
Percent	5.79	1.64	6.35	.60	2.66	1.86	1.98	
RECSAD #4	287	77	256	31	110	99	86	4304
Percent	6.67	1.79	5.95	.72	2.56	2.30	2.00	
RECSAD #5	29	8	26	3	11	10	9	430
Percent	6.74	1.86	6.05	.70	2.56	2.33	2.09	
Sampled	2	0	0	0	0	4	0	49
Percent	4.08	0	0	0	0	8.16	0	

TABLE XII

WHITE RIVER

CONDITIONS:	
RECSAD #1:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.25
RECSAD #2:	Participation rate (per 100,000) = 500
	Percent willing to travel median dist. = 0.25
RECSAD #3:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.10
RECSAD #4:	Participation rate (per 100,000) = 1000
	Percent willing to travel median dist. = 0.05
RECSAD #5:	Participation rate (per 100,000) = 100
	Percent willing to travel median dist. = 0.05

VITA

Ricky Lee Jones

Candidate for the Degree of

Master of Science

Thesis: COMPARISON OF DISTANCE DECAY PATTERNS AMONG RECREATIONAL USERS FOR SIX CENTRAL U.S. RIVERS

Major Field: Geography

Biographical:

Personal Data: Born in Oklahoma City, Oklahoma, July 29, 1956, the son of Mr. and Mrs. Herman E. Jones.

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