SIMULATING CHANGES IN RECREATIONAL TRAVEL PATTERNS AND THEIR EFFECTS ON A RECREATION SYSTEM: AN APPLICATION OF RECSAD

By

MILES GRANT LOGSDON

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1975

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
May, 1979

Thesis
1979
L832s
Cop. 2

OKLAHOMA STATE
UNIVERSITY
LIBRARY

SIMULATING CHANGES IN RECREATIONAL TRAVEL

PATTERNS AND THEIR EFFECTS ON A

RECREATION SYSTEM: AN

APPLICATION OF RECSAD

Thesis Approved:

R. D. Heard
Thesis Adviser

Stephen W Tweedie

James L. Reed

Norman N Durham
Dean of the Graduate College

1029420

PREFACE

This study was concerned with the use of a computer program for modeling recreation behavior within a recreation system. That element of the recreation experience which determines the individual's willingness to travel based upon fuel cost and availability, and the impacts of changes in that willingness was explored.

It was through the guidance of Dr. Richard Hecock and Dr. Steve Tweedie that this study was begun, however, without the flexibility and professional training of Mr. Jim Reed, its completion was questionable. Although their assistance can never be repaid, the many hours that these gentlemen spent in the computer center, the office, and at home righting the wrongs, turning right-side-up those things upside-down, and generally creating fresh ideas when old ones wouldn't work, I give my greatest appreciation.

The opportunity does not often arise to acknowledge one's friends and supporters in print. I therefore offer my thanks to the Texans who said I should, the P & D staff who said I could, and my family, Becky and Sam, who said it didn't really matter.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

ENERGY AND RECREATION TRAVEL: A REVIEW

Introduction

On December 13, 1973, in the office of Secretary of the Interior Rogers Morton, a meeting was convened of key people in the recreation industry, the Bureau of Outdoor Recreation, and other government agencies. The recent oil embargo had prompted this meeting which was concerned with the impact on the energy crisis on recreation. Indications at that time pointed to large increases in the price of fuel for all uses, and especially for gasoline. Fuel rationing seemed inevitable, and the recreation industry feared mandatory reduction would begin with them.

Gasoline rationing appeared in some cities, while everywhere there were shortages and higher prices. It was widely anticipated that changing conditions of fuel supplies or prices would have serious long-term impacts upon recreational travel behavior. In this thesis, a computer was used to simulate possible changes in recreational travel behavior resulting from changes in energy availability or costs, and their effect on a recreation system.

Trends in Travel Behavior

Over two hundred years ago Benjamin Franklin felt his society was entering an age in which leisure would be available to rich and poor alike. In fact, every generation since the industrial revolution has seen futurists predict that a leisure-centered society was just around the corner (Smith, 1974).

In America, our advancing technology has made available new and faster forms of transportation. Pleasure cars and airplanes have turned remote vacation sites into realistic destinations for a two week, or even a three-day vacation period (Wirths, 1974).

Recreational travel and its relationship with cost, time, and attractiveness, has become a major area of research. Barry O'Rourke (1974), in a comprehensive literature review of the subject, identified four broad groupings which serve to summarize the direction of research efforts in recreation travel. These groups are: (1) inventory and descriptive studies; (2) behavioral studies; (3) economic studies; and (4) studies based on travel models.

In all types of travel study, the travel distance is considered as a major factor, although it is not always agreed that distance has a negative function. Colenutt (1968) found that the effects of distance vary with the type of recreational trip. In addition, Wolfe (1970) indicated that long travel distances appeal to some recreationists. Clawson (1966) also viewed travel to and from the park as part of the total experience, and G. Wall (1973, p. 129), a British geographer, went so far as to conclude that "the pleasure of driving is more important a motive than the attraction of a particular destination."

In 1969 Keogh's study into the effects of travel time as a recreation determinant stated that 86% of the drivers enjoyed the time spent traveling although their choices of routes were based on different factors. Travel time as a determinant in travel behavior has been a neglected element of the recreational experience. The amount of time people spend traveling to a day-use regional area generally equals the amount of time they spend on-site (Keogh, 1969). In the case of day-use activities, therefore, travel time becomes a strong determinant. The time spent traveling to sites for long weekend or vacation stays becomes less determinant than in the case of day trips.

The theory of attraction was described by Voorhees (1955, p. 46), "All trips are pulled or attracted to various land uses in accordance with certain empirical values." Later efforts at measuring park attraction included studies by Cesario (1964) and also by Ellis (1969). Despite the apparent failure of these studies to quantify park attraction conclusions indicated that site selected is based on some perceived attraction (Mercer, 1971).

Tiedeman and Milstein (1966) began a discussion of travel cost as a determinant in recreation travel. Later, Seneca (1968) stated that increased income and leisure time have reduced the constraints of travel cost. The position that travel cost is not a determinant of recreational travel behavior for high income groups or in short leisure trips remains in dispute.

The recreationist, when making his choice of sites, must decide which site will meet his needs in terms of travel distance and time, attraction, and cost. These decisions determine his travel behavior. As yet, no empirical studies have shown which, if any, of the three factors has the greatest impact on recreational travel.

Effects of the "Energy Crisis"

A survey conducted by the National Recreation and Parks Association in January, 1974, immediately after the Washington meeting, investigated the effects of fuel shortages, known by now as the "energy crisis."

During a six-month period between August, 1973, and January, 1974, 40% of the reporting agencies indicated a marked change in the use of their facilities. Twenty-five percent of the agencies experienced a 10% decrease, while 15% of the agencies experienced a 10% increase in use. Decreased usage occurred mostly at state-administered facilities; but some state and regional areas experienced an unexpected upswing in usage.

Although visitation at National Park Service areas declined by 13% during the 1973-1974 oil crisis, this was due more to a shortage of supply and the closing of service stations on Sundays than to a change in price. With the lifting of the oil embargo in April of 1974, second quarter visitation rates at National Park Service sites showed only a 5% decline (U.S. Department of the Interior, 1974, p. 18). Opinion Research Corporation (1975) surveyed the public during 1974 and determined that 43% of the respondents planned to travel the same number of miles again in 1975.

Additional research concerning the effects of the energy crisis was conducted by Alfonso Zapata in 1975. Utilizing park registration data from 1972 through 1974 which recorded the users' residences, the changes in travel distance of park users were identified. The study concerned itself with three sites which experienced a substantial increase in visitation during the period from 1973 to 1974. This increase occurred almost entirely from an area within 100 miles of each site, which in all three cases included a large urban center.

The duration of trips taken to these sites remained virtually unchanged. Users who lived within 100 miles of a site, however, generally increased the number of times they visited that site, while those users beyond 100 miles reduced their number of visits. Unfortunately, the impact of these changes on the adequacy of a recreation system remains questionable, generating considerable interest.

While the private automobile accounts for 90 to 95% of all recreational travel, some shifts were recorded toward use of mass transportation (U.S. Department of Transportation, 1975). The 1977 Heritage, Conservation, and Recreation Services (HCRS) National Outdoor Recreation Survey asked respondents whether the present price of gasoline had caused them to use public transportation for outdoor recreation purposes, and 15% responded that it had (U.S. Department of the Interior, 1978).

Possible Effects of the "Energy Crisis"

In the late 1970s, the American society, with its increasing dependence on technological advancement, is facing a potential fuel crisis. Recreationists today realize that although opportunities for extensive travel still exist, the cost of such travel will increase as fuel supplies decrease. Recent predictions by a 19-nation International Energy Agency pointed to major oil shortages and substantially higher prices by 1985 (Washington Post, June 6, 1978).

The recreationist who formerly enjoyed extensive travel will continue to travel, but the frequency of his trips and the length of stay at his destination may change. Those persons who desire a wilderness experience will continue to travel to wilderness sites. The desire to recreate will still exist, but trips will be more carefully planned; with closer destinations for weekend outings and longer vacation stays at more distant recreation sites. A study in Wisconsin identified a positive relationship between vacation travel changes due to higher fuel cost and socio-economic and demographic factors (Corsi and Harvey, 1978).

The price elasticity of demand has been described as slightly inelastic (Bureau of Outdoor Recreation, 1973, p. 13). For the activity of camping, a 1% increase in fuel price will result in a .15% decrease in the quantity consumed. This price inelasticity of demand suggests that participation may be relatively insensitive to higher fuel prices.

On the other hand, a Heritage Conservation Recreation Service task force offered the following observations:

> The extent to which future energy prices will impact recreation depends upon an increase relative to the rate of inflation, wage and salary increases, and changes in tax rates. In constant 1973 dollars, gas prices rose initially at the time of the oil embargo by 10¢ per gallon, then dropped 3¢ per gallon from this early rise, leaving a real increase of only 7¢ per gallon. Since 1974, the price of gasoline has risen at a slower rate than inflation. Additionally, real income of production workers in 1978 is higher than it was in 1974. These facts help to explain why, for example, people have not drastically altered their travel characteristics simply because the price of gasoline has increased--its 'real price' has not increased significantly. For those individuals who have purchased more fuel efficient cars, their relative expenditures on travel may have decreased. Whether future increases in gasoline prices impact recreation travel depends upon the price of gasoline as a proportion of real disposable income.
>
> Total per capita expenditure toward recreation travel has grown steadily since 1955. Furthermore, the temporary declines in this growth during the recessions of 1958, 1970-71, and 1974-75, were less than that which should

> have been expected from a conventional construction of recreation expenditures as discretionary. Possibly a change is occurring in people's minds concerning the importance of recreation, and it is becoming more of a necessity in their lives and less a luxury.
>
> Based on recreational area visitations, by 1990, there will be about 1.55 times as much recreational travel as in 1975. Recreational travel will grow about 3% per year, a lower rate than observed over the past 10 to 20 years. This projection is based on a 'no surprise' future and recognizes, for example that even with a doubling of price for petroleum products in the last few years, there has been essentially no impact on recreational travel. Highway travel for recreational purposes will grow more rapidly than total highway travel, probably 1.5 to 2 times as rapidly (U.S. Department of the Interior, 1978, p. 10).

Dr. Stephen Smith (1974), in his presentation to a Michigan symposium entitled "Leisure Under the New Conditions of 'Tight Energy'," postulated that:

> . . . the American family will continue to recreate, especially if economic conditions permit them to do so. If gasoline is available, although expensive, within broad limits, tourism will not be substantially affected. If supplies are uncertain, or conservation methods are effective, the shift in recreation will be to activities such as sailing, tent camping, fishing, cycling, or other less consumptive activities. The recreation industry as a whole has always been quite successful. Those types of recreational activity that are fuel consumptive or require a unique environment, such as snowmobiling or off-road vehicles, can understandably expect fewer and less frequent return visits. The popularity of these activities will undoubtedly attract new participants from those who are able to pay (p. 1).

As the studies cited previously indicate, the shift in travel behavior resulting from the energy crisis creates some fairly predictable effects, while other effects are less obvious. Claudine Wirths (1974) of the Maryland State Department of Natural Resources, voiced the feelings of many recreation planners, "Overnight facilities in more distant areas may well become even more popular because they will permit the maximum recreation time to be squeezed out of each tankful of gas" (p. 18).

Returning to the study conducted by the National Recreation and Parks Association (1974), 36% of the agencies expect a decrease in facility use, while 23% anticipate an increase. Changes will occur in every recreation system. Each system is faced with the assurance that sites closer to urban areas will become more popular; while more distant sites will be sought for prolonged visits. These shifts in recreational travel and usage did have and will continue to have serious implications in problems of overuse, resource protection, and maintenance of a quality recreational experience.

As the availability of fuel changes, effects will certainly be felt by the recreation industry. As fuel availability decreases, decision-makers may respond by closing stations, rationing supplies, or raising prices. It has not been shown that increasing fuel prices has had, or will have, a major effect on recreation travel. Decreasing availability of fuel may produce regulation of the use of that fuel, which would require that the consumer plan his recreational trips as an element of his total allotment. Depending on the method used, rationing would have a subtle and uniform effect on travel. As supplies of petroleum continue to decrease, gasoline shortages may cause periodic closings of retail gas stations. If this occurs, the consumer will not know from one day to the next (or from one town to the next), whether fuel will be available. Gas station closings would have the greatest and most unpredictable effects on recreation travel of the alternatives discussed here.

Objectives of This Research

The previous discussion indicated that changes in recreation travel behavior have occurred in the past and that they are likely to continue to occur in the future. Many of these changes have come about due to a shortage of gasoline and resulting high fuel costs. It was basic to this research to understand the relationship between the availability and cost of fuel, and travel behavior. A link was assumed to exist between reactions to changing conditions of fuel and a reduction in participants' willingness to travel.

Along with these changes, empirical studies have shown that increased usage, and therefore increased stress on some recreation sites has occurred. When attention was taken away from the individual sites and focused instead on a network or system of parks, the importance of shifts and changes in travel behavior may be seen. For the administrator or decision-maker responsible for acquisition and development of a park system, or for the planner or researcher assisting in that task, the modeling of a dynamic relationship between a resource and its users becomes a powerful tool.

The goal of this research was two-fold: first, to simulate travel behavior in a recreation system (a collection of population centers and the recreation sites which serve them), and second, to identify management alternatives available to decision-makers and asssess their impacts on the recreation system. The specific objectives to be achieved in accomplishing this goal are:

1. To adapt the RECSAD computer program to simulate the effects of distance on recreation travel.[1]
2. To use RECSAD to model travel patterns within a recreation system.
3. To simulate changes in recreational travel in terms of distance.
4. To identify the possible effects of management alternatives on the recreation system.
5. To evaluate RECSAD as a tool for assessing and planing for recreation systems.

---

[1]RECSAD: A computer program for recreational planning by S. W. Tweedie and R. D. Hecock of the Department of Geography at Oklahoma State University.

CHAPTER II

MODELING TRAVEL BEHAVIOR

Introduction

In modeling recreation travel, methods presently employed by recreation planners often utilize "sufficiency standards." Sufficiency standards focus attention upon individual parks, however, and not upon the total recreation system. These standards require knowledge of only two variables: acreage requirements per capita and distance of the user from the park. An example of a standard is "20 acres for every 1,000 people, with a service radius of 100 miles." This standard is often used in connection with assessing adequacy of regional parks.

Many questionable assumptions are made when such standards are used to evaluate recreation resources and to justify new parks. Standards, when applied to individual sites assume: (1) that facilities with the same intended function do not vary in quality; (2) that park use will remain constant throughout the day, week, and even year; and (3) that if more than one park is within the specified travel distance (or service area) of a city, each park draws the total participating population from that city. In other words, people who live in overlapping service areas are used to justify the existence and development of competing parks. This "double counting" of demand does not give a realistic view of the true demand upon each individual park.

RECSAD

Double counting is the major problem faced when using sufficiency standards. The planner has no feel for where people will go to recreate, given more than one site within a reasonable travel distance. The RECSAD computer program attempts to give the planner an idea of how a population will apportion its demand among various elements of the recreational system. The program works on the assumption that people have a knowledge of which parks are likely to be overcrowded and which will be less used. The program also assumes that people prefer a less crowded park close to their residences.

The current planning approach, which does not compensate for double counting is termed the "fixed radius method." In this approach, the maximum distance traveled for recreation is fixed; meaning that the park serves the demand within a given radius of itself. In this way, each park has a defined service area, and no demand is expected from population centers outside the service area. For some recreation activities, the fixed radius approach may yield the most realistic model results.

To overcome the problems associated with double counting, the RECSAD program assesses conditions under the fixed radius option in two ways. First, it assesses conditions of maximum expected use, reflecting the outcome of the participating population visiting all sites within its travel radius. This condition illustrates the worst possible situation, which is unlikely to occur at any one recreation site, and which cannot possibly occur simultaneously throughout the system. Secondly, it assesses conditions of probable use, portraying a situation where each participant visits only one site within his travel radius. In this way, a more realistic view of probable park use is given. The following example briefly describes the method used by the program to apportion demand from each population center to recreation sites within their fixed travel radius.

A recreation site has a "capacity" of 100 units, with "capacity" being a measure of the number of people able to recreate at any given time. Two population centers, A and B, are both within a reasonable distance of the recreation site. Population Center A has a demand of 450 units, while Population Center B has a demand of 50 units. It is obvious that the total demand from Center A cannot use the recreation site at the same time, but the demand from Center B can. The program apportions the demand from each population center, based upon the percent of total demand for the recreation site that each population center constitutes. In the example, the demand from Population Center A makes up 90% of the total demand, while Population Center B represents 10%. Based on this, the 100 units of supply at the recreation site would be filled by 90 units from Population Center A and by 10 units from Center B. For the computer, this calculation becomes an iterative procedure, which bases its next calculation on the previous outcome. If the example had been more complex, using two recreation sites within the distance of both population centers, the program would have continued to reapportion demand until the change in the ratio between park capacity and park use at each park reached an equilibrium. This equilibrium calculation represents the probable supply-demand relationship, based on the assumption that people seek the less crowded condition.

The RECSAD program is able to cope with the problem of demand and supply from outside the study area, affecting the study area. This "boundary problem," as it has been called, is eliminated by including data about the population and associated parks that lie immediately outside the study area. The program refers to population centers and recreational sites within the study area as centers or sites of interest.

Previous use of the RECSAD program has been limited. In the original publication of the program, recreation opportunities for boating in Oklahoma were examined (Tweedie, 1975). In addition, RECSAD was used to assess the urban recreational day-use opportunities in Oklahoma City (Oklahoma Statewide Comprehensive Outdoor Recreation Plan, 1974).

In order to utilize RECSAD in simulating travel behavior, the program was adapted to more realistically represent the effects of distance on travel behavior through use of a distance decay curve option. The curve simulates the attraction that close recreation sites have, along with the appeal of more remote areas.

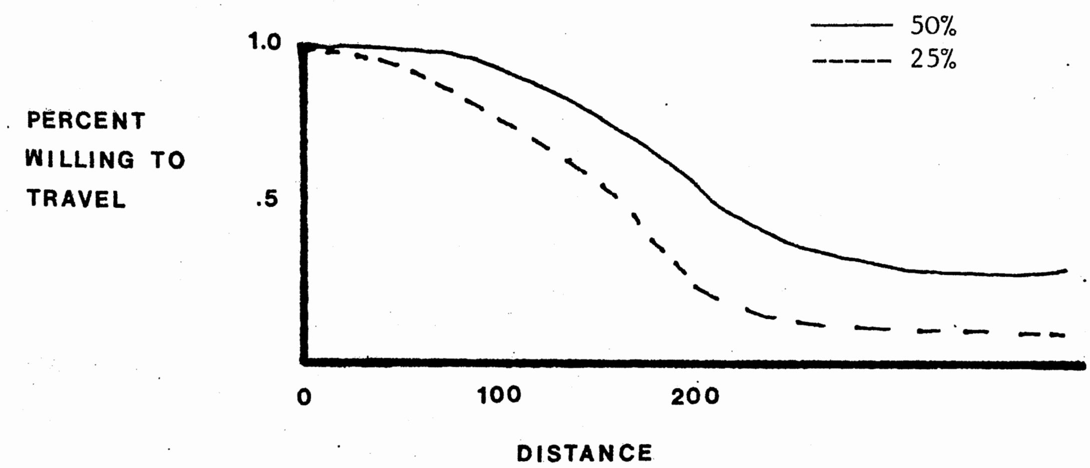
The basic curve has the shape of the right half of the normal curve, and represents the relationship between distance (on the x-axis), and the proportion of the population willing to travel a given distance (on the y-axis). These values start at 1.0 (at distance = 0), and approach zero as distance increases.

Two conditions determine the position of these curves. First, the median distance to all recreation sites is calculated separately for each population center. Centers that are far removed from most recreation sites, such as locations in western Oklahoma, will have large median distances compared with places in the eastern part of the state. Second, willingness to travel with respect to the median distance is introduced as a constant proportion throughout the system. This value can be changed from one run to the next to simulate changes in travel costs or willingness to travel.

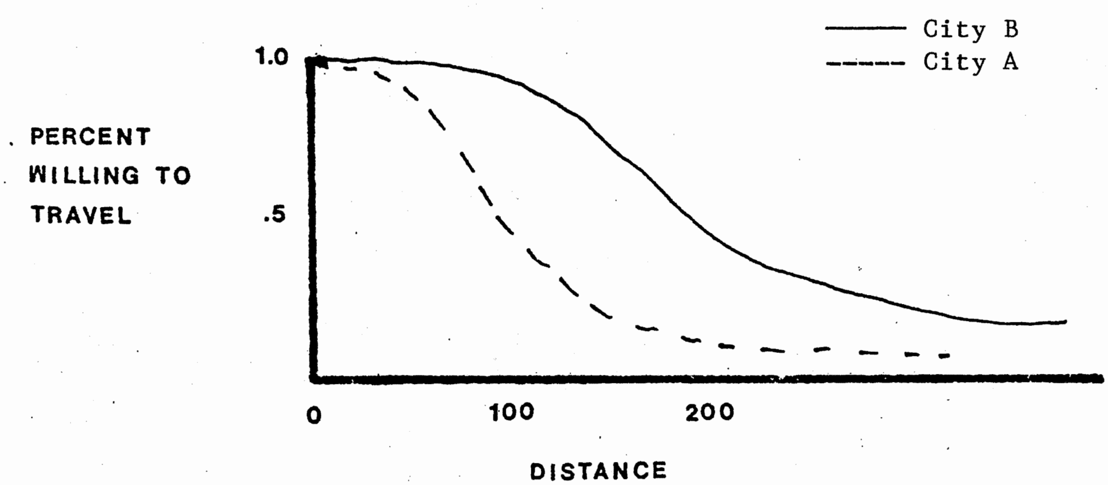
The result of these two conditions is that decay curves for specific population centers can be elongated or compressed depending on the input conditions. Figure 1(A) shows the effect of dropping the proportion willing to travel the median distance from 50% (curve 1), to 25% (curve 2), with a median distance of 200 miles. This would depict a situation where high travel costs curtail travel in general.

Figure 1(B) shows a comparison of two cities with different median distances. City A has a median distance of 100 miles compared with 200 miles for City B. In Oklahoma, this would approximate the situation for Tulsa and Guymon. In each case, 50% of the people were willing to travel the median distance, but because of differences in access to the recreation system, residents of City B were willing to travel further.

Since RECSAD is designed to assign <u>all</u> demand to recreation sites, curves depicting the number of users vs. distance traveled under differing conditions will intersect. Assuming a decreased willingness to travel, as illustrated in Figure 1(A), users will be forced into nearby recreation sites, as depicted in Figure 2(A). Assuming that cites A and B have equal populations, Figure 2(B) shows the <u>number</u> of users, compared with distance traveled for the situation illustrated in Figure 1(B). People poorly served by the recreation system make a greater number of long distance trips.

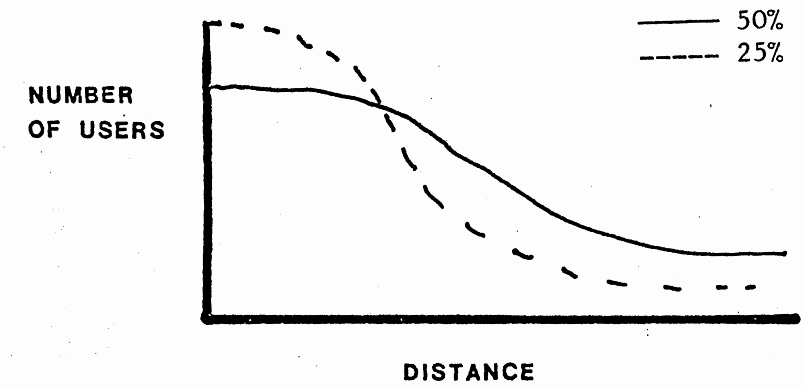


(A)

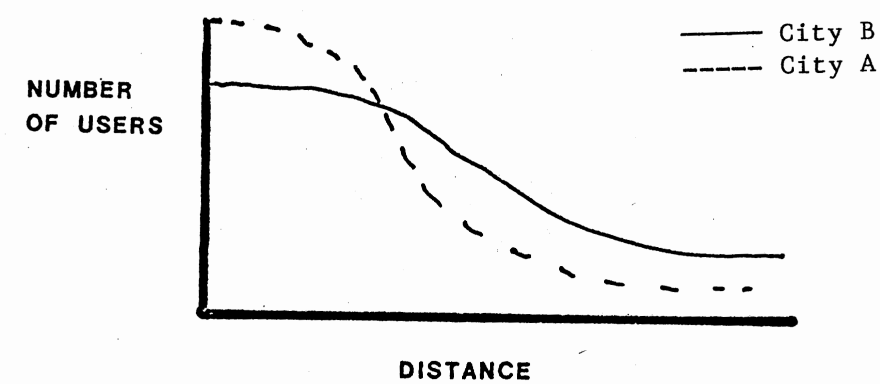


(B)

Figure 1. Proportion of the Population Willing to Travel the Median Distance



(A)



(B)

Figure 2. Number of Users Apportioned By Distance

Finally, both participation rates for specific population centers, and attractiveness of individual recreation sites, can be varied independently. These RECSAD options would influence the ideal shapes of the above curves. They have not been used in the present study.

Hypothetical Example

To illustrate the use of the median distance decay curve, the following simple example is offered.

Two population centers, Center A, with a median distance of 100 miles to all recreation sites, and Center B, with a median distance of 200 miles, are the only sources of recreation demand in this example. Servicing this demand are recreation sites at distances of 50, 100, 150, 200, 250, and 300 miles.

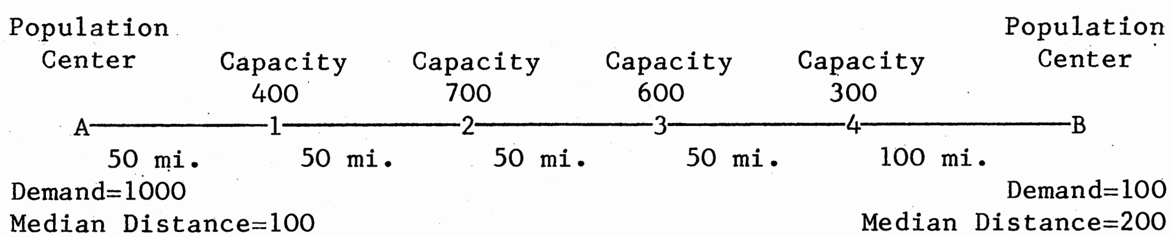


Figure 3. Illustration of Demand From Two Population Centers

Table I indicates the proportion of the population willing to travel the distance to each recreation site, based on the probability that 50% of the population will travel the median distance.

TABLE I

FIFTY PERCENT WILLING TO TRAVEL MEDIAN DISTANCE

Center	Median Distance	50	100	150	200	250	300
A	100	.84	.50	.21	.06	.01	.00
B	200	.96	.84	.68	.50	.34	.21

If only 25% are willing to travel the median distance, the probabilities decline accordingly (Table II).

TABLE II

TWENTY-FIVE PERCENT WILLING TO TRAVEL MEDIAN DISTANCE

Center	Median Distance	50	100	150	200	250	300
A	100	.71	.25	.04	.00	---	---
B	200	.92	.71	.46	.25	.11	.04

The flow of supply and demand between these population centers and recreation sites at 50% willingness to travel the median distance is calculated by the following steps, and shown in Table III.

1. The probability of traveling the distance to each recreation site is calculated from the median distance decay curve.

TABLE III

SUPPLY AND DEMAND AT FIFTY PERCENT WILLING TO TRAVEL MEDIAN DISTANCE

Center	Site	Probability	Capacity/ Demand	Adjusted Probability	Proportional Use	Users
A	1	.84	0.4	.34	.405	405
	2	.50	0.7	.35	.417	417
	3	.21	0.6	.13	.155	155
	4	.06	0.3	.02	.023	23
			TOTAL	.84		1000
B	1	.34	1.0	.34	.14	14
	2	.50	1.0	.50	.21	21
	3	.68	1.0	.68	.29	29
	4	.84	1.0	.84	.36	36
			TOTAL	2.36		100

2. These values are multiplied by the ratio of capacity at the recreation site to the demand from the population center, to adjust the drawing power of those sites. The reasoning behind this adjustment is that a recreation site that is small relative to the demand of the population center should have limited appeal since it would be quickly overrun. Capacity/Demand ratios greater than 1.0 are set at 1.0.
3. The resulting adjusted probabilities are then summed.
4. The proportional use at each recreation site is determined by its relative contribution to the sum.

5. The number of users at each recreation site is calculated by multiplying the total demand from the population center by the proportional probability of each recreation site.
6. Dividing the capacity of each recreation site by its total number of users, the degree of overuse or underuse is determined.

For Center A, 84% of the population are willing to travel the 50 miles to recreation site 1, but only 50% are willing to make the 100 mile trip to site 2. In contrast, 84% of the residents of Center B are willing to travel the 100 miles to recreation site 4, their nearest opportunity. In general, people at Center B, with fewer recreation opportunities in the vicinity, are more willing to make longer trips.

In the calculation, site 1 can only accommodate 40% of the demand, site 2, 70%, etc., and the probabilities are adjusted accordingly. The result is that site 2 attracts more users (417) than site 1 (405), in spite of its greater distance. Users from Center A are forced to travel farther than they would prefer because the large demand overwhelms the nearest site. For Center B, with its smaller demand, the capacity of the recreation sites is not an important factor.

Distance is also a less important determinant for Center B than for Center A, and its assigned use is much more evenly distributed. For example, 65% of the users from Center B travel at least 150 miles, compared with only 18% of those from Center A.

CHAPTER III

APPLICATIONS OF RECSAD

This chapter discusses the recreation system for weekend camping trips in the state of Oklahoma.

RECSAD Input

The three hundred forty-four population centers within the system are the population centers of the 1970 Census County Divisions (Figure 4). Recognizing that competition for capacity can be expected from population centers outside of Oklahoma, the counties surrounding Oklahoma are included in the system, along with the recreation sites they contain. The "boundary problem" is thereby compensated for to ensure a more realistic view of travel patterns.

The 111 recreation sites within the system are identified as areas supplying the support facilities for weekend overnight camping opportunities (Figure 5). Because of the difficulty in defining boundaries of camping areas, identified campsites, as opposed to acres of land for camping, are used to determine capacity in this instance. This information on identified campsites, both for tents and recreation vehicles was obtained from the 1977 Oklahoma Statewide Comprehensive Outdoor Recreation Plan facility inventory, and was supplemented with Woodall's Directory of Camping (1977).

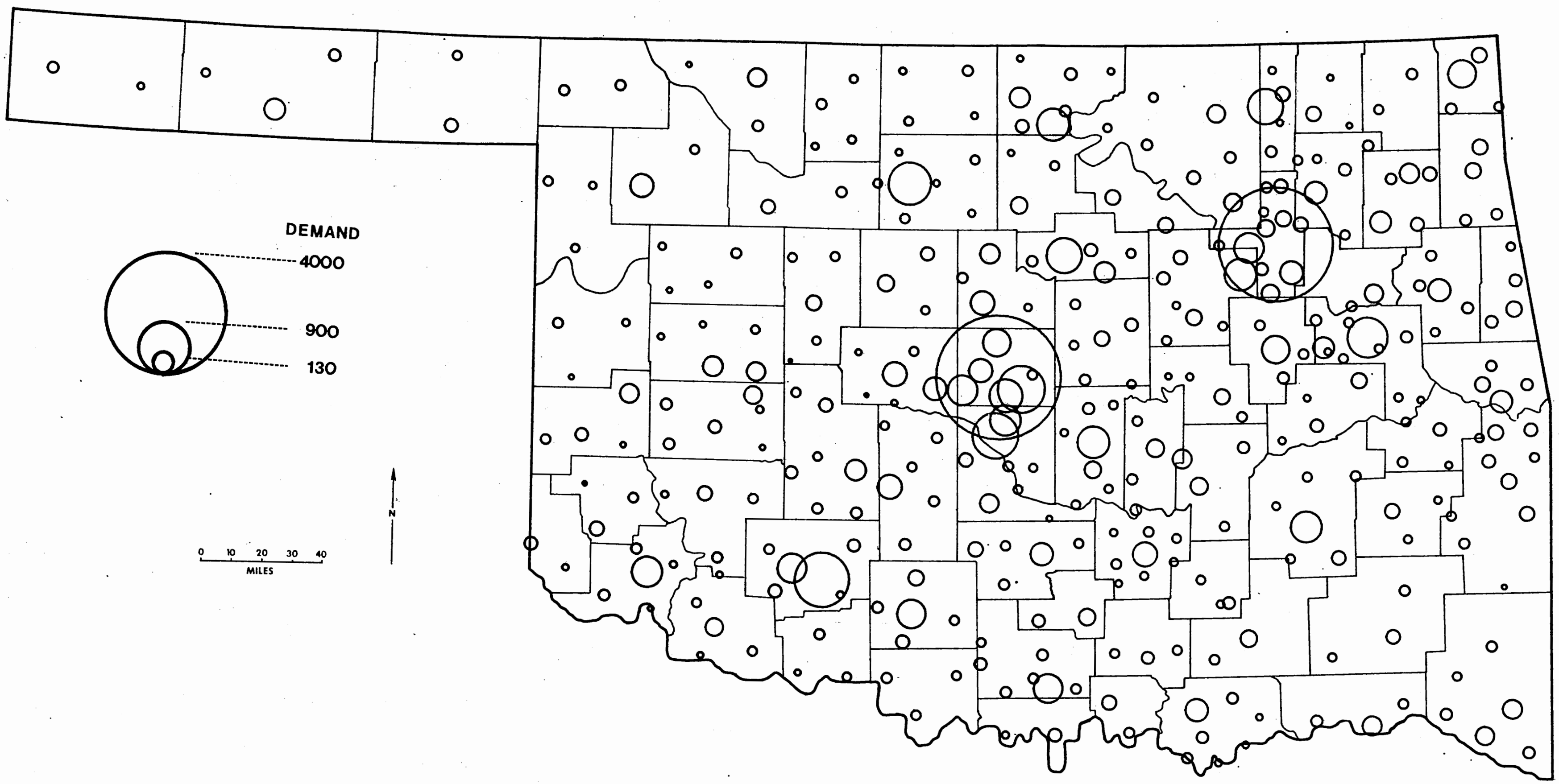


Figure 4. Demand for Weekend Camping Trips in Oklahoma

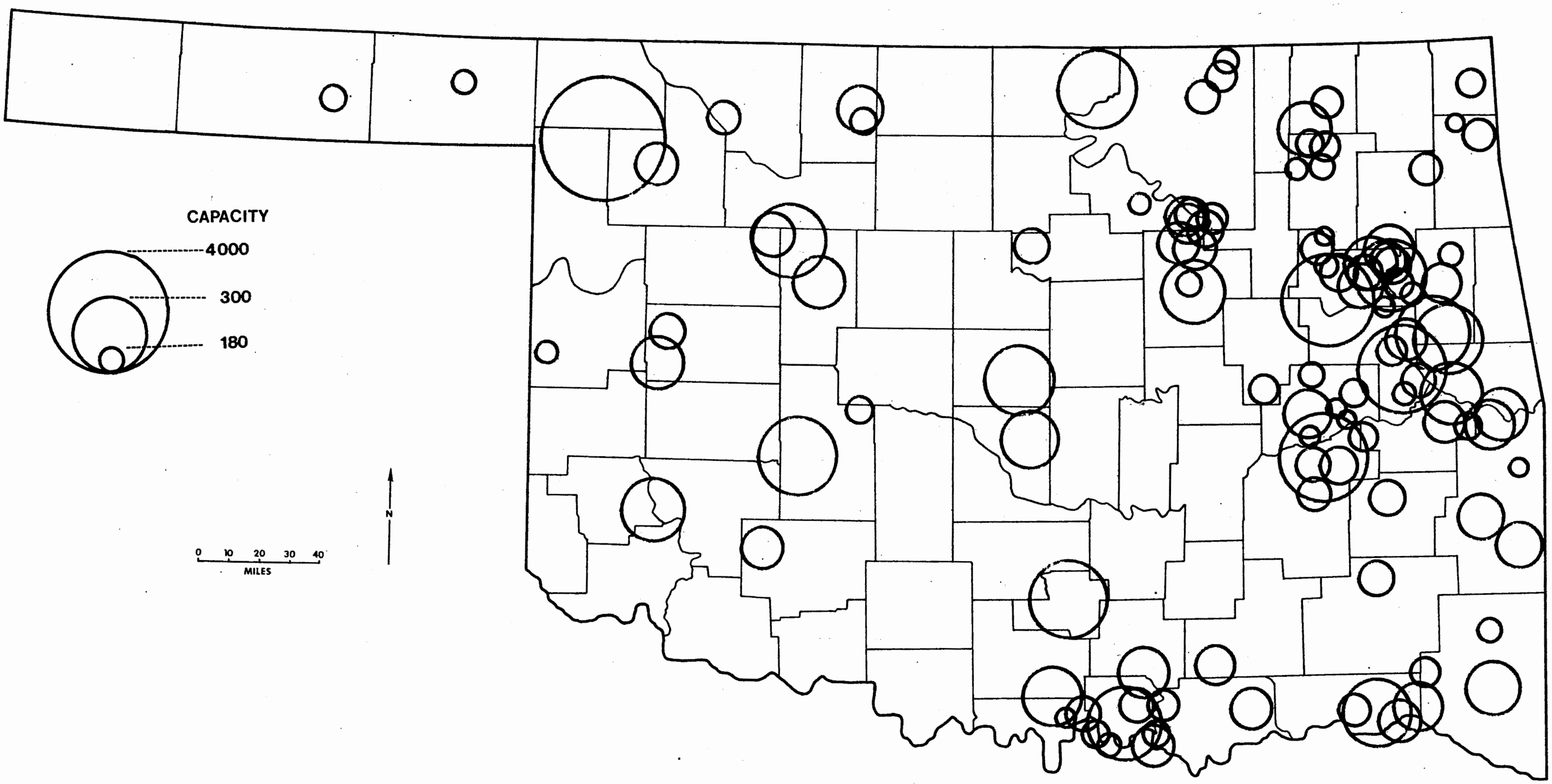


Figure 5. Capacity for Weekend Camping Trips in Oklahoma

Table IV is a list of the input required by the RECSAD program.

TABLE IV

RECSAD INPUT CONDITIONS

Number of Population Points	= 469
Number of Population Points of Interest	= 344
Number of Recreation Sites	= 158
Number of Recreation Sites of Interest	= 111
Scale (Km or Miles Per Inch)	= 28.000
Participation Rate (Per 100,000)	= 1200.0
Capacity Per Unit Facility	= 4.0000
Percent Willing to Travel Median Distance	= 0.10

Examples

A combination of factors influences the degree to which any recreation site is used. The factors of park capacity and park location act as key determinants in this evaluation.

To better illustrate the effects of the median distance decay curve and to assist in explaining the output of the RECSAD program, four examples of park capacity and demand will be offered. These examples will illustrate the effects of decreased willingness to travel on individual recreation sites and population centers. The four examples include:

1. A large population center with good access to recreation areas.

2. A large population center remotely located from recreation sites.

3. A large recreation site near a large population center.

4. A large recreation site remotely located from population centers.

The output of RECSAD, using the median distance decay approach, is divided between reporting on the efficient use of recreation sites and the degree of services to the population centers. The terms used in the program will be explained along with a discussion of the examples. The attraction of each recreation site is assumed equal; sites are distinguished by their relative capacity.

A Large Population Center

(Oklahoma City)

As the percent of the population willing to travel the median distance increases, the number of users finding a recreational opportunity would also be expected to increase. Table V shows the increases in fulfilled demand from the large population center of Oklahoma City, as willingness to travel increases. This population center is located near the center of the system with a median distance of 114 miles to all recreation sites within that system. Figures 4 and 5 illustrate the distribution of population centers and recreation sites within this system.

TABLE V

EFFECTS OF INCREASED WILLINGNESS TO TRAVEL

% Willing to Travel	Occasions of Demand	Effective Capacity	Capacity/Demand Ratio	Latent Demand	Median Distance
10	4643	3712	.80	930	114
90	4643	4170	.90	473	114

Referring to Table V, the demand from this center remains the same, as expected. The effective capacity, or the amount of recreation units used by this center increases. This would also be expected, because a larger percent of the population is willing to go farther and either occupy sites that previously went unused or displace users from other origins.

The capacity/demand ratio indicates the relationship between the capacity available to the center and the demand from that center. A ratio above 1.0 indicates a surplus, while a value below 1.0 indicates a deficiency in supply. A 1.0 to 1.0 relationship is ideal.

Latent demand is a measure of unfulfilled demand occasions. It is a function of the distance from the population center to its recreation site, and the demand of competing population centers for existing capacity. In this example, the amount of latent demand decreases as more people are willing to go farther.

A Large Remote Population Center

(Guymon)

Located in the extreme western part of this recreation system, Guymon, a large population center for this area, is farther from recreation sites. Table VI indicates the satisfaction of this population center as the willingness to travel increases.

TABLE VI

EFFECTS OF INCREASED WILLINGNESS TO TRAVEL

% Willing to Travel	Occasions of Demand	Effective Capacity	Capacity/Demand Ratio	Latent Demand	Median Distance
10	134	107	.80	27	297
90	134	102	.77	31	297

In this instance an increase in the willingness to travel has very little impact on latent demand or effective capacity. A higher willingness to travel causes greater competition from distant population centers at all recreation sites, resulting in slightly fewer opportunities available to participants from this population center.

The capacity/demand ratio indicates a deficiency of supply at both travel distances.

A Large Recreation Site, Near a Large Population Center (Little River State Park and Oklahoma City)

The measures used in quantifying the efficiency of recreation sites are quite simple. The capacity, as described before, is a fixed amount, depending upon the standard used to convert the sites' physical facilities into units of demand which they are capable of serving. The "users" referred to are the number of demand occasions which would be willing to travel to this recreation site, given the selected willingness to travel. A capacity/use ratio is used to illustrate the crowding condition. A value above 1.0 would indicate a surplus of capacity, while a value below 1.0 would indicate overcrowded conditions.

The figures in Table VII indicate that as the willingness to travel increases, the crowded conditions at this recreation site decrease.

TABLE VII

EFFECTS OF INCREASED WILLINGNESS TO TRAVEL

% Willing to Travel	Capacity	Users	Capacity/Use Ratio
10	860	1310	.66
90	860	812	1.06

A Large Remote Recreation Site

(Boiling Springs State Park)

In this example, the recreation site is located at a considerable distance from large population centers. As the percent willing to travel the median distance increases, the underused remote site becomes accessible to more users, and it experiences overcrowded conditions. The figures in Table VIII indicate this change.

TABLE VIII

EFFECTS OF INCREASED WILLINGNESS TO TRAVEL

% Willing to Travel	Capacity	Users	Capacity/Use Ratio
10	464	410	1.13
90	464	507	0.92

Present System Status

Existing empirical use figures for overnight camping at 20 recreation sites were found to correlate best with the RECSAD modeling assumption that 25% of the participating population was willing to travel the median distance.

Table IX describes the program's predicted use figures for 20 sample recreation sites at 25% willingness to travel and the areas' recorded attendance data (U.S. Army Corps of Engineers, June, 1978). The relationship of high or low use was correlated at a Pearson correlation coefficient of 0.6695, at a significance of 0.001. Some sites are combined in the table because of their close proximity to each other.

TABLE IX

PREDICTED AND RECORDED USE DATA

Recreation Site	Predicted Daily Use	Recorded Monthly Attendance
Spencer Creek	337	11,500
Big Creek	339	48,000
Horseshoe Bend	622	66,800
Petit Bay	430	8,100
White Horn Cove	402	47,000
Rocky Point	602	34,000
Flat Rock Creek	460	5,700
Panther Creek	219	600
Pine Creek	347	400
Juniper Point	447	4,800
Platter Flats	482	11,100
Buncombe Creek	515	16,300
Hickory Creek	337	2,700
Cowskin Bay	636	9,500
Washington Irving	579	22,300
Heyburn Park	1115	9,900
Salt Creek Cove	704	40,300
Ponca Creek	1137	19,300
Wolf Creek	805	44,100
Taylor Ferry	524	67,100

Referring again to Figures 4 and 5, the relative supply/demand relationship for the camping recreation system can be seen. Focusing the attention on the adequacy of the recreation sites, Figure 6 illustrates the capacity/use ratio of all recreation sites at a 25% willingness to travel.

In terms of the total system, there were 82,918 demand occasions and a total capacity of 81,564. Table X summarizes the situation for Oklahoma and the surrounding states.

TABLE X

ORIGINS OF RECREATION SITE USERS

		Recreation Sites		
		Oklahoma	Out-of-State	Total
(Users' Origins)	Oklahoma	26,904	3,786	30,690
	Out-of-State	38,651	13,577	52,228
	Total	65,555	17,363	82,918

The cumulative travel distances for all users are shown in Table XI. Note that the average travel distance is about 100 miles.

The RECSAD model indicates that at the present willingness to travel, a majority of the recreation sites are overused. Underused sites, however, are scattered among overused sites. The large underused site near the panhandle, Fort Supply Recreation Area, dominates the system with a supply that is nearly twice that of any other site. There is some suspicion that this capacity figure is inflated.

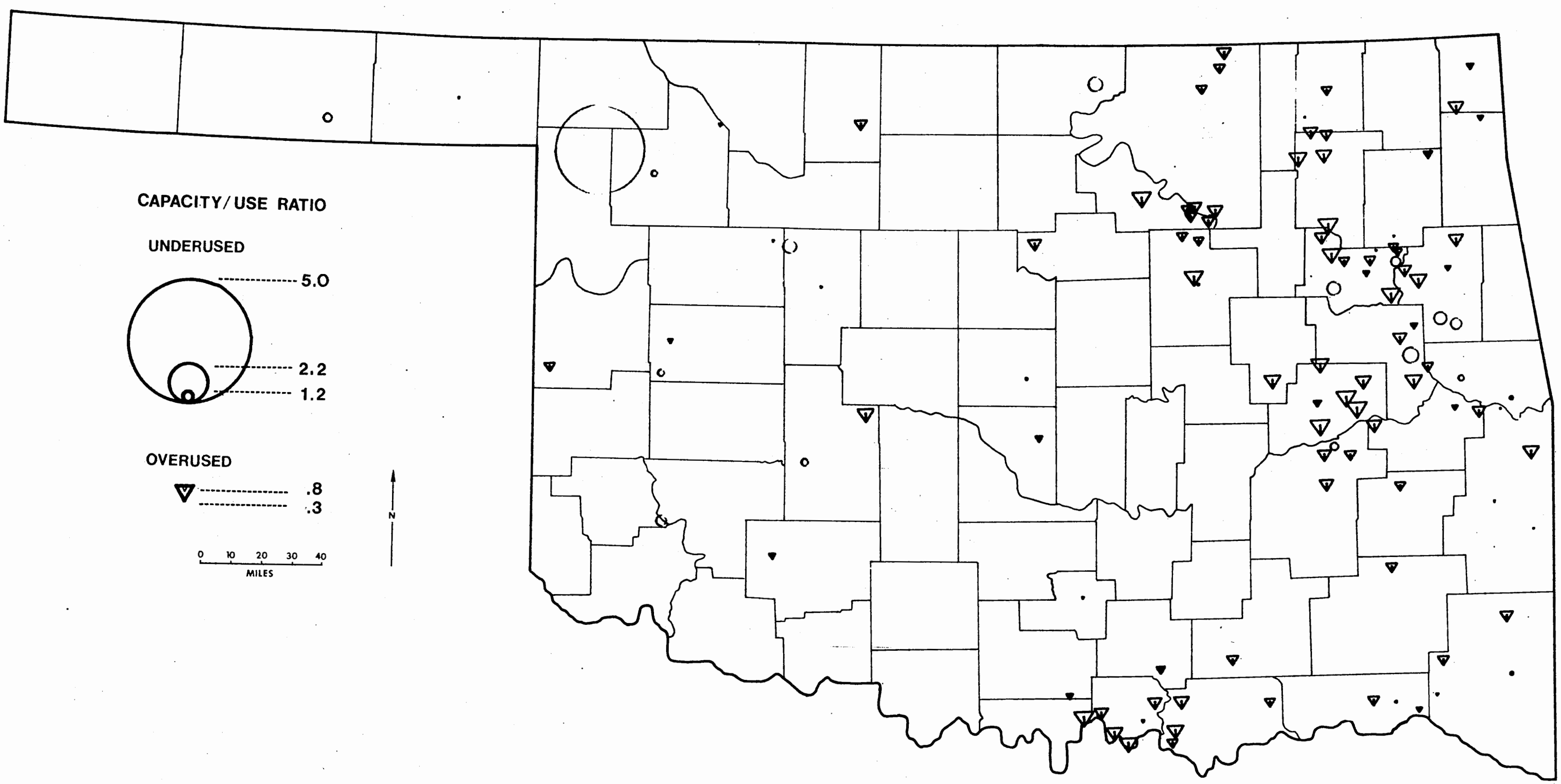


Figure 6. Capacity/Use Ratio--25% Willing to Travel

TABLE XI

CUMULATIVE TRAVEL DISTANCE

Distance	Number of Trips	Cumulative Trips	Percent
0		82,693	100
25	5,410	77,283	93.5
50	8,613	68,670	83.0
75	13,801	54,869	66.4
100	13,357	41,512	50.2
125	11,413	30,099	36.4
150	7,394	22,705	27.5
175	7,506	15,199	18.4
200	5,388	9,811	11.9
225	3,994	5,817	7.0
250	1,832	3,985	4.8
275	1,293	2,692	3.3
300	899	1,793	2.2

As expected, most recreation sites in eastern Oklahoma are overused to some degree, while in western Oklahoma underused areas are more common. Since use is based on the willingness to travel the median distance, and the more remote population centers of western Oklahoma are further from recreation opportunities (e.g., have a longer median distance), residents in the West must travel to the more numerous sites in the eastern half of the state.

Possible Effects of Future Changes

It is believed by some that increased fuel costs, rationing, and/or fuel shortages and gas station closings will cause a reduction in willingness to travel. Figure 7 illustrates the capacity/use ratio of the recreation sites if only 5% are willing to travel the median distance, a reduction of 80% of the previous example.

Although for the total system the amount of supply and demand remains the same, patterns of park usage change somewhat (Table XII).

TABLE XII

ORIGINS OF RECREATION SITE USERS
AT FIVE PERCENT

		(Recreation Sites) Oklahoma	Out-of-State	Total
(Users' Origins)	Oklahoma	28,273	2,418	30,691
	Out-of-State	35,050	17,177	52,227
	Total	63,323	19,595	82,918

The average travel distance at 5% willingness to travel is about 75 miles (Table XIII), a reduction from slightly over 100 miles (Table XII).

Figure 8 illustrates the relationship between the distance decay for the total system under conditions of 25% and 5% willingness to travel the median distance.

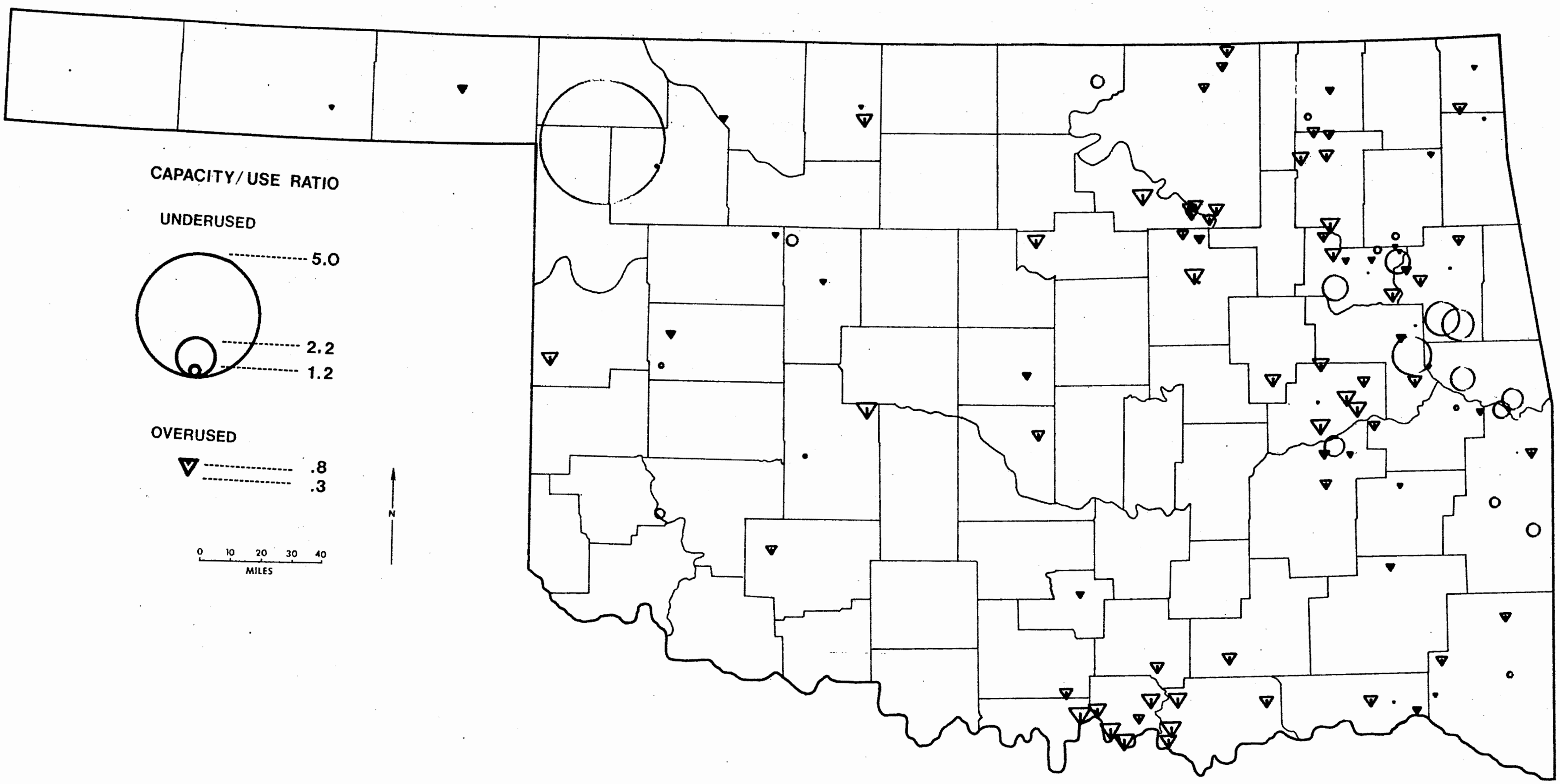


Figure 7. Capacity/Use Ratio--5% Willing to Travel

TABLE XIII

CUMULATIVE TRAVEL DISTANCE

Distance	Number of Trips	Cumulative Trips	Percent
0		82,712	100
25	9,858	72,854	88.1
50	13,275	59,579	72.0
75	19,002	40,577	49.1
100	14,817	25,760	31.1
125	9,935	15,825	19.1
150	5,189	10,636	12.9
175	4,627	6,009	7.3
200	2,408	3,601	4.4
225	1,486	2,115	2.6
250	651	1,464	1.8
275	483	981	1.2
300	335	646	0.8

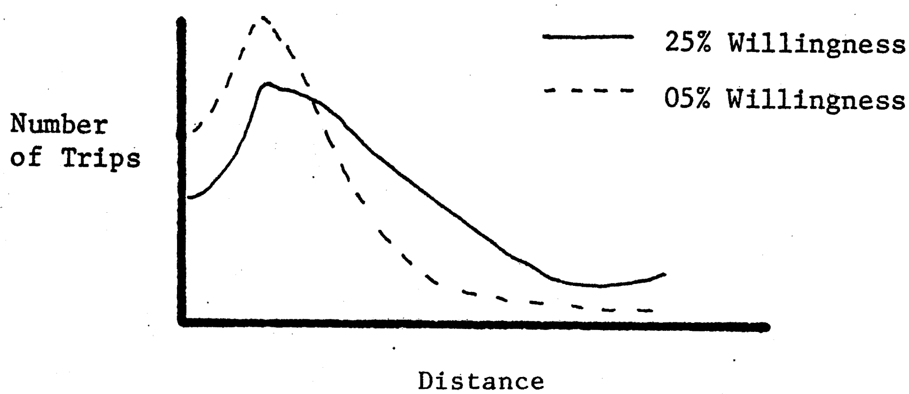


Figure 8. Cumulative Distance Decay Curve

Findings

Figures 6 and 7 indicate the presence of underused sites in the east central section of the state, on Tenkiller and Robert S. Kerr Reservoirs, despite their proximity to the large population centers of Tulsa and Fort Smith. When willingness to travel decreases, they receive even less use, while other nearby overused sites fluctuate very little.

Because the proportion willing to travel has been reduced, the number of trips from each population center to distances at and beyond the median distance has decreased. Use has shifted, resulting in an increased number of shorter trips throughout the system. Thirty-seven sites increased their usage, while seventy-four received fewer users. Four sites changed from being underused to being overused, while usage at one site resulted in a change in the reverse direction. One of the implications of this possible shift may be that regionalization of usage change may occur. In the situation illustrated above, all of the south central and western recreation sites received more use when the willingness to travel was reduced. The eastern recreation sites being more numerous, received less use. Figure 9 illustrates the regionalization of the shift in usage and the present capacity/use ratio.

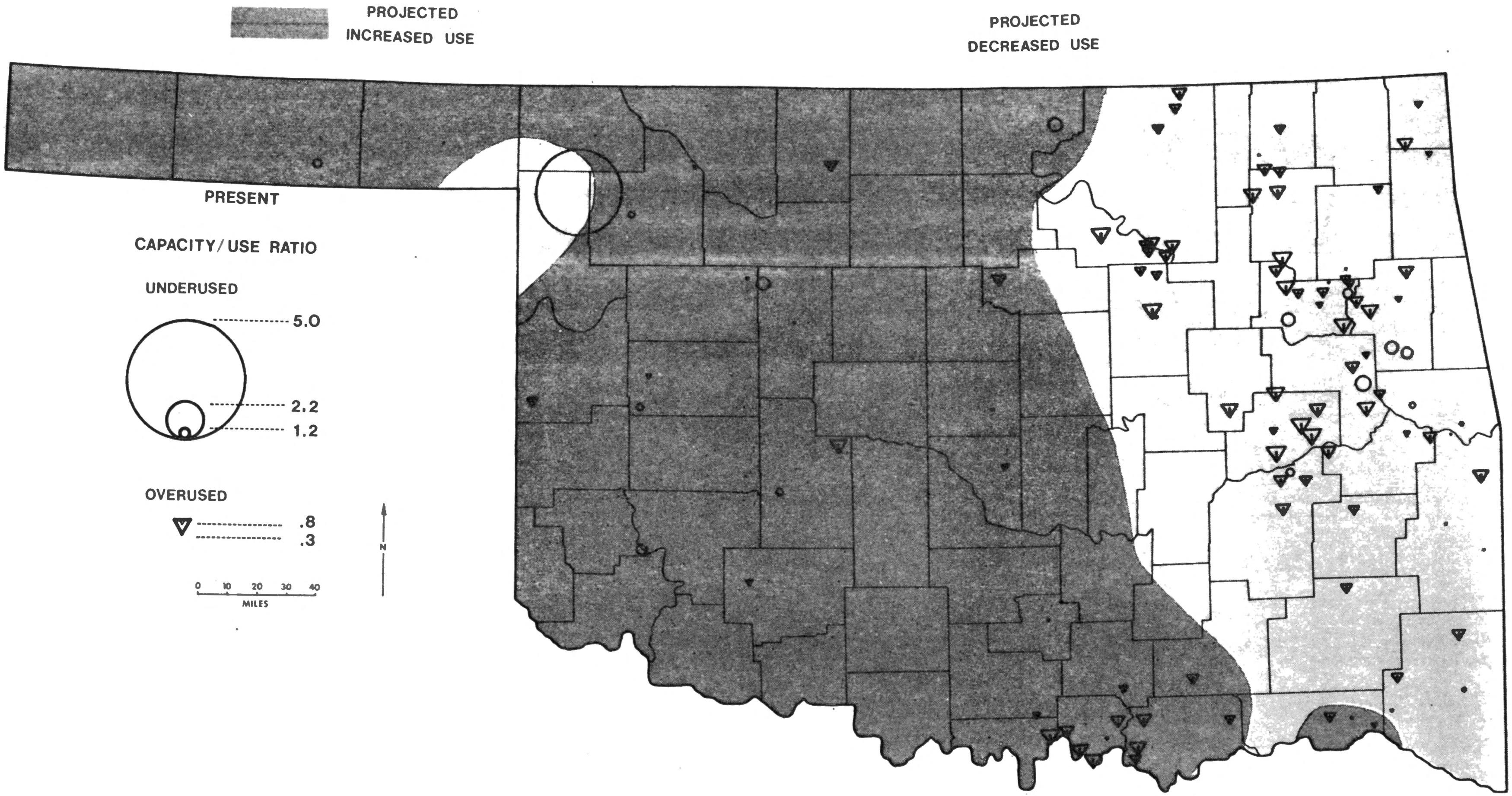


Figure 9. Increases and Decreases in Use

CHAPTER IV

CONCLUSIONS

Introduction

The impact which the 1973 oil embargo or the possibility of future energy shortages had, or will have, on recreational travel is uncertain. Experience and logic suggest that visitation will decline at some recreation areas while increasing at others. Users' travel patterns have shifted and will continue to shift, but these shifts have not always been predictable when viewed as isolated situations.

As people encounter problems of increasing fuel costs and decreasing fuel availability, they will have to make decisions about their preferences in recreational experiences. Some may choose to take fewer trips to distant sites and stay longer; others may opt for shorter, more frequent excursions. Still others may choose to use public transportation rather than drive their own automobiles. Fuel consuming recreational activities may decrease, while fuel conserving activities increase. The cost for equipment may cause the cost for fuel to be of little importance.

Implications for Planners and Decision-Makers

The development of the RECSAD computer program was undertaken in order to model travel patterns within a recreation system. In

RECSAD, travel is not simply portrayed as the flow between individual population centers and recreation sites. Rather, it is believed that the RECSAD program may be used as a tool for evaluating changes both in individual recreation sites and in an entire recreation system. This versatility may be useful in determining impacts from changing energy conditions.

With the aid of the RECSAD program, planners may be able to anticipate critical areas in the recreation system. In one application of modeling camping opportunities in Oklahoma, willingness to travel was assumed to decrease by a substantial amount. The simulation portrayed conditions of overuse at a majority of all recreation sites. Underuse did occur at a few clustered areas of east central and western Oklahoma. The decrease in willingness to travel projected an increase of use in the western two-thirds of the state. The eastern third, although more heavily supplied with camping opportunities, was projected to receive less use.

Sites presently overused which are predicted to experience increased use because of fuel shortages are critical in terms of future management decisions. The planner should investigate the alternatives of increasing the capacity of existing recreation sites or of creating new sites to meet the demands of users.

Reservation procedures for recreation facilities might be refined to ensure their availability to long-distance travelers. Under conditions of fuel rationing or gas station closings, the recreationist will be forced to more carefully plan his trip, therefore destinations will have to be selected and confirmed in advance.

Tourism and travel promotion must play a greater role in attracting users to previously underused recreation sites. Promotion programs might also focus on encouraging the public to make use of recreation facilities during non-peak periods. In addition, the out-of-state visitor must be increasingly viewed as a regular user of state facilities.

The private sector of the recreation industry should be encouraged to provide recreation opportunities in areas of increasing use. This might be accomplished through increased cooperation of state and federal agencies on issues such as the availability of liability insurance. Future planning for mass transit should be routed to include recreation opportunities.

If decreased fuel availability results in longer and less frequent trips to recreation sites, attention must be given to providing high quality experiences through environmental education and recreation programs. By developing programs of activities as well as a wide variety of recreational opportunities, the park manager will encourage return visits of longer duration. User fees should be examined in light of longer visits, which could make them feasible on a maintenance-cost basis. The effects of many of these activities could also be simulated using RECSAD, giving planners a clearer perspective of their overall impact on the total system.

Advantages of RECSAD

As described earlier, the RECSAD program does eliminate "double counting." By utilizing the computer, the standards approach and its problems may be averted and more realistic views of peoples' choices may be modeled. The individual recreation site is no longer viewed in isolation from the total supply/demand system. With the distance decay option the use from each population center is apportioned depending upon its individual decay curve, which is in turn based on that center's median distance to all recreation sites.

The advantages of RECSAD in terms of predictions are two-fold. First the program can be used to predict the status of the recreation system under present conditions. Measures of a recreation site's underuse or overuse may be compared to empirical use data, as population centers are evaluated as to their underserved or overserved status. Second, RECSAD may be used to predict future changes in the system--changes either in users' behaviors or in the system's physical development.

Disadvantages of RECSAD

A basic assumption of the RECSAD program is that users will prefer the least crowded recreation sites closest to where they live. This assumption is probably accurate for selected activities; however, certain activities would likely present unique distance decay curves. In large systems, smaller sites with little capacity may receive unrealistic amounts of overuse due to their locations. These conditions may be addressed in the preparation of the input by combining nearby sites. The size of a site in terms of capacity has not yet been adequately defined to allow consistent or uniform measurement of this variable. Capacity figures must be carefully constructed to ensure that they present a realistic view of the system.

Recommendations

In future research, a link between changes in fuel conditions and specific recreation behavior must be established. Studies investigating distance traveled, length of stay, and frequency of trips must be empirically grounded to provide realistic input for RECSAD. The information on recreation demand elasticity with price must be examined in order to more accurately describe the effects that fuel constraints will have on recreation.

Improvements in the RECSAD program itself must address intervening opportunities and barriers to the recreationist's travel. Differing modes of travel as well as the possibility of the use of a network travel system should be considered in order to provide a more realistic picture of the travel system. This may include planning for the future use of public transit systems for recreation purposes. Finally, unique distance decay curves for different recreation activities should be easily incorporated into the program when desired.

As managers and decision-makers are faced with the problems of changing patterns of recreational demand, adjustments to the recreation system must be based on a reasonable evaluation of their impacts. While environmental, social, and political influences must play a role in planning and decision-making, new analytical tools are needed to evaluate the basic ingredients of the recreation system and the impacts that changes will bring. The RECSAD approach is believed to be a useful tool in recreation planning.

BIBLIOGRAPHY

Cesario, F. J. "Operations Research in Outdoor Recreation." Journal of Leisure Research, 1 (1969), 33-43.

Clawson, M. and J. L. Knetsch. Economics of Outdoor Recreation. Baltimore: Johns Hopkins University, 1966.

Colenutt, R. J. "Modeling Travel Patterns of Day Visitors to the Countryside." Area, 1 (1969), 43-47.

Corsi, T. M. and M. E. Harvey. "Toward a Causal Model to Explain Differing Household Vacation Patterns As A Result of Higher Fuel Prices." Journal of Leisure Research, 10 (1978), 298-310.

Dicke, Karen P. "National Park Service Areas' Visits Up 9.8% in 1975." Journal of Travel Research, XV (Summer, 1976), 10-12.

Ellis, J. B. A Systems Model for Recreational Travel in Ontario: A Progress Report. Ontario: Department of Highways Report RR126, 1967.

Keogh, B. M. "The Role of Travel in the Recreation Day Trip." (Unpub. M.S. thesis, University of Western Ontario, 1969.)

Mercer, D. "The Role of Perception in the Recreational Experience: A Review and Discussion." Journal of Leisure Research, 3 (1971), 261-276.

National Recreation and Parks Association. "Public Parks and Recreation: A National Perspective." Parks and Recreation, 9 (1974), 7a.

Oklahoma Tourism and Recreation Department. Statewide Comprehensive Outdoor Recreation Plan. Oklahoma City, Oklahoma, 1977.

Opinion Research Corporation. General Public Behavior and Attitudes Regarding Vacation and Business. July, 1975.

O'Rourke, B. "Travel in the Recreational Experience--A Literature Review." Journal of Leisure Research, 6 (Spring, 1974), 140-156.

Seneca, J. J., P. Davidson, and F. G. Adams. "An Analysis of Recreational Use of the T. V. A. Lakes." Land Economics, 44 (1968), 524-529.

Smith, S. L. "Leisure Under the New Conditions of Tight Energy." University of Michigan Symposium: How Will the Food and Energy Shortages Affect Outdoor Recreation in Michigan? (March, 1974).

Tiedemann, C. E. and D. Milstein. "Travel Models: Methods and Models." Michigan Outdoor Recreation Demand Study, 1 (1966).

Tweedie, S. W. and R. Hecock. RECSAD: A Computer Program for Recreation Planning. Stillwater: Oklahoma Water Resources Research Institute, 1976.

U. S. Army Corps of Engineers. Park Attendance Data (Unpublished Computer Printout.) Tulsa, Oklahoma, 1978.

U. S. Department of Interior, Bureau of Outdoor Recreation. Outdoor Recreation: A Legacy for America. Washington, DC: Government Printing Service, 1973.

U. S. Department of the Interior, National Park Service. Public Use of the National Park System: Calendar Year Report, 1974. Washington, DC: Government Printing Service, 1975.

U. S. Department of the Interior, Heritage Conservation and Recreation Service. 1978 Nationwide Outdoor Recreation Plan, Energy Conservation and Outdoor Recreation, Task Force Report. Washington, DC: Government Printing Service, 1978.

U. S. Department of Transportation, Office of the Secretary. Recreation Access Study. Washington, DC: Government Printing Service, 1975.

Voorhees, A. "A General Theory of Traffic Movement." Proceedings of the Institute of Traffic Engineers. October, 1955, 46-56.

Wall, G. "Car Owners and Holidays." Town Planning Review, 44 (1973), 117-130.

Washington Post. "Energy Department Seeks to Deregulate Gasoline." June 6, 1978.

Wirths, C. G. "Energy and Environment: A Study in Time." Parks and Recreation (April, 1974), 17a-19a.

Wolfe, R. I. "Vacation Homes and the Gravity Model." Ekistica, 29 (1970), 352-353.

Woodall's Campground Directory, 1977, North American Edition. Highland Park, IL: Woodall Publishing Co., 1977.

Zapata, A. "Recent Changes in Patterns of Origin and Destination of Recreational Vehicle Recreationists." (Unpub. M.S. thesis, Oklahoma State University, 1975.)

VITA $^{\nu}$

Miles Grant Logsdon

Candidate for the Degree of

Master of Science

Thesis: SIMULATING CHANGES IN RECREATION TRAVEL PATTERNS AND THEIR EFFECTS ON A RECREATION SYSTEM: AN APPLICATION OF RECSAD

Major Field: Geography

Biographical:

Personal Data: Born in Tulsa, Oklahoma, April 23, 1953, the son of Mr. and Mrs. J. W. Logsdon.

Education: Graduated from Tulsa East Central High School, Tulsa, Oklahoma, in May, 1971; received Bachelor of Science degree in Urban Forestry from Oklahoma State University in December, 1975; enrolled in the graduate program at Oklahoma State University, 1976-1977; completed requirements for the Master of Science degree in May, 1979.

Professional Experience: Forest Technician, Weyerhauser Company, summer, 1972; assistant forester, City of Tulsa, Oklahoma, summer, 1974; park technician, U.S. Army Corps of Engineers, summer, 1975; permanent position with the Oklahoma Department of Tourism and Recreation, Division of Planning and Development, on the Statewide Comprehensive Outdoor Recreation Plan, 1976.